FORESIGHT

Designing a Future for Health

Futures Scanning

Report

December 2019

Created in partnership with and based on the research of

VISION FORESIGHT STRATEGY

FORESIGHT is an initiative of The Rippel Foundation, created in partnership with Blue Shield of California Foundation. It is actively supported by forward-thinking national and regional philanthropic partners.

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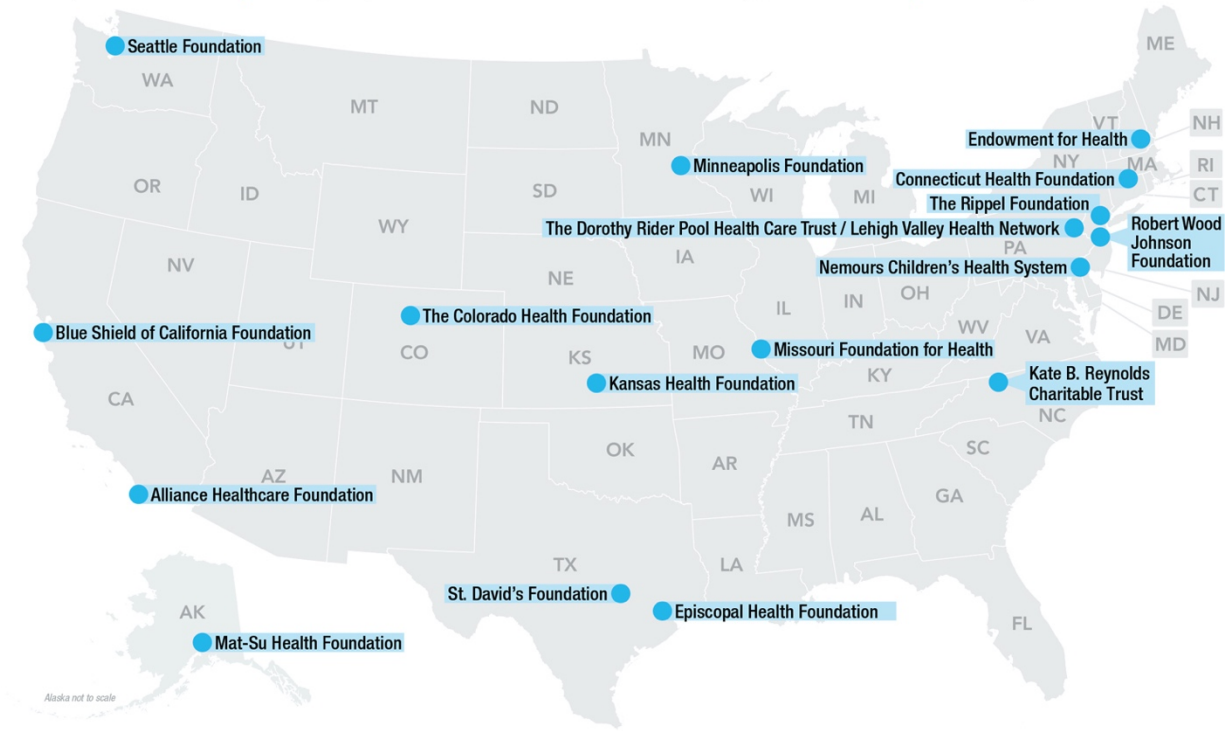

Vision Foresight Strategy LLC (VFS) is a foresight and strategic analysis firm headquartered in Honolulu, Hawai'i.

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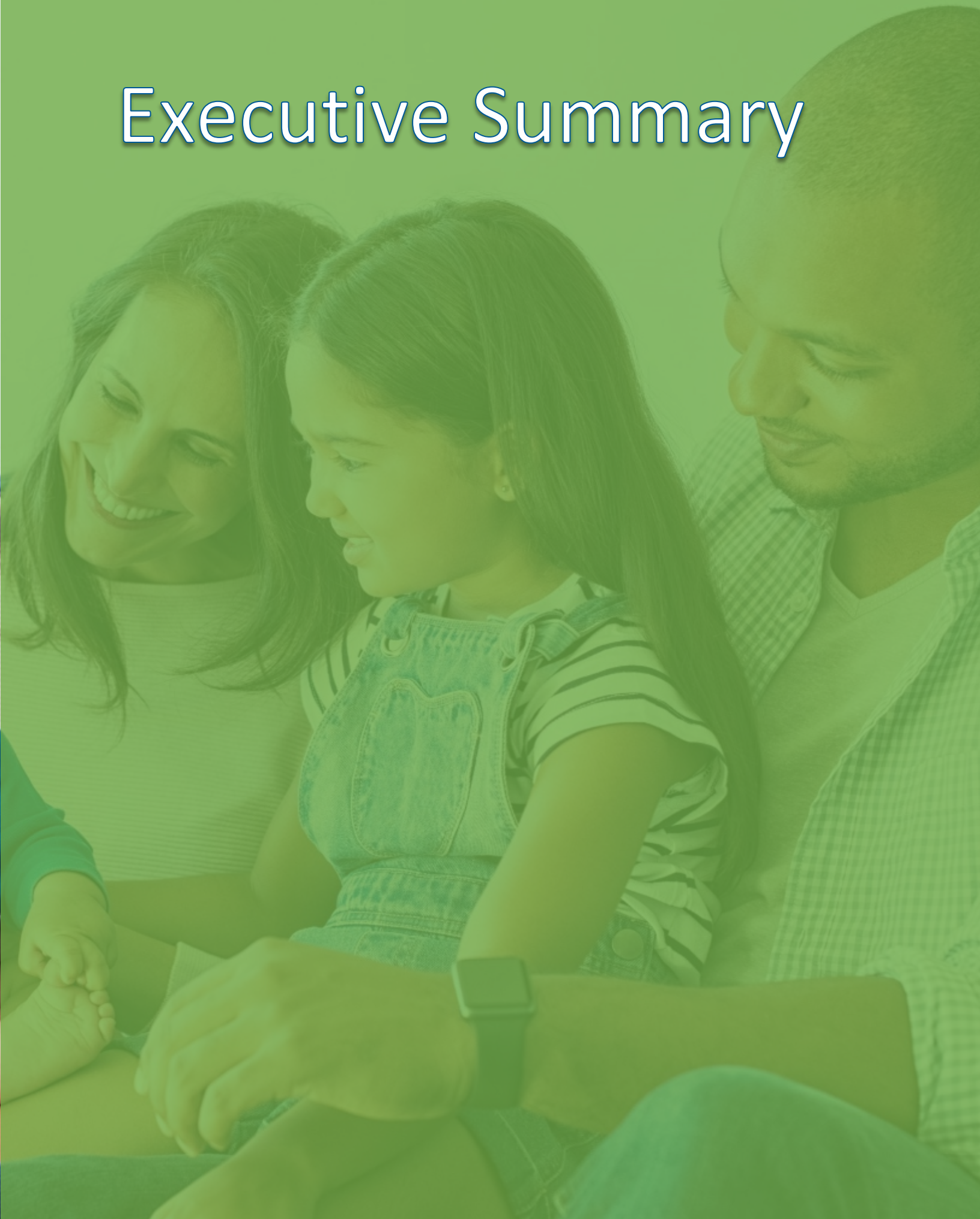
Executive Summary



This Futures Scanning report supports FORESIGHT, an initiative of The Rippel Foundation. FORESIGHT was created in partnership with Blue Shield of California Foundation, and is actively supported by forward-thinking national and regional philanthropic partners. It is a visionary futures learning journey that will involve thousands of Americans in reconceptualizing health and redesigning systems to enable lives of better health and well-being throughout the United States.

In conditions of dynamic, fast-moving, and transformational change, it is necessary to pursue bold new strategies and solutions to advance health and well-being under new paradigms. Collaborative foresight and community dialogue are central to this effort. FORESIGHT has partnered with futures researchers, designers, community facilitators and members –especially those who are currently and historically marginalized- and others to support the long-term visioning and action needed for real change. The effort will connect over-arching global and national changes, policies, and initiatives, and ultimately result in community and regional action that advances new visions of health and well-being.

Futures of Daunting Challenges and Transformative Potential

Based on this Futures Scanning effort, the U.S. has passed into a period of considerable – and increasing – turbulence, one created by the overlap and intersection of multiple types of change. On the horizon major shifts in society promise to be strategic and disruptive in their impacts. Increasing environmental crises could lead to more public health crises; technological innovations could offer extraordinary capacity to observe, analyze and alter both ourselves and our environment; and the most diverse generation this country has seen will soon mature as health consumers. The U.S. will need to navigate this confluence of environmental, systemic, and cultural transformations. This turbulent context will bring uncertainty, anxiety, and overreactions, as well as hope, opportunity, and innovation. Some of the more strategic transformations, which are all, to varying extents, already underway, include:

- *Geopolitical landscape:* power, influence, and preferences for the future are shifting dramatically on the global stage. The U.S.'s position and stature in the world is changing, and the assumptions and ties that might have bound the peoples (and economies) of the world are loosening. The implications for the U.S. economy, optimism, and worldview are considerable.
- *Climate crisis:* as the world's climate changes, sea levels are rising, temperatures are rising, ecosystems are shifting, and devastating extreme weather is increasing in frequency and severity. The impacts on well-being are direct, indirect, and multiplying. The risks to homes and communities, increasing health and disease risks, and the impacts to agriculture, fishing, and food supply chains are just some of the more obvious implications. As more economies mature, accelerated resource

consumption will amplify the climate crisis, and also add to health risks by adding more toxins and pollutants to the environment.

- *Cultural*: recent politics in the United States have prominently featured the ascendance of leaders espousing ostensibly conservative values intended to appeal to predominantly white voters. Yet longer-term trends clearly indicate a citizenry growing gradually more liberal and diverse, and in the years ahead those trends will continue and could accelerate. With younger, more diverse, liberal generations moving towards political significance in the mid to long-term, the U.S. has already begun a potentially historic shift in its popular and political culture.
- *Machines*: one of the most talked about potential transformations arises from accelerating innovations in areas such as computing, robotics, and machine intelligence. There is a rapid proliferation of new forms of automation, increasingly connected devices (the Internet of Things), and increasingly capable machine-controlled devices. In the not-too-distant future, ecosystems of machines may evolve and come to structure, guide, and constrain our daily lives in ways too varied and complex for us to understand.
- *Biology*: biotechnology, ranging from genetic therapies to cutting-edge synthetic organisms, has greater potential to transform society than even machines. Researchers are using engineered lifeforms to produce goods and energy; are tweaking species genetically such that they pass their new characteristics on to their offspring; and are creating entirely new lifeforms from scratch. The profound risks and potentials in being able to precisely and consistently modify life on Earth, from the microscopic to the macro, cannot be understated.

The urgency and breadth of the major issues that could impact U.S. health and well-being could outstrip our individual capacity for adaptation as well as our current, collective incentives for action. Looking ahead, adaptation and solutions may be possible, but will require conscious and sustained efforts to cultivate and implement. Given the negative trends underway and the structural impediments to change, it is unlikely that positive, systemic change will occur without concerted and informed action.

There is, fortunately, much light on the horizon. New technologies, new ideas, and new social movements offer significant potential for dramatically improving health and well-being in the U.S., and significant reason for hope … if their potential can be unleashed.

Looking Back: Past Drivers of Change in Health and Well-being

Key historical drivers of change in U.S. health and well-being include federal law and policy, social movements, advancing medical science and technology, broad economic transformations in areas such as the food industry and the healthcare sector, and the worldwide integration of trade and economies characterized by globalization. Moving

forward into the future, these historical forces will continue to influence the shape and pace of change.

In addition to these drivers, health and well-being have been shaped by the movement of several long-term, re-occurring cycles. The up and down shifts of U.S. equality/ inequality, of liberal/conservative politics, and of urban/suburban growth have affected the context for well-being and as they progressed have made positive change for large numbers of citizens more or less difficult. These and other cycles are expected to continue to play important shaping roles, however it is unclear when they will shift and how far.

Trends: The Current Directions of Change

Many of the trends related broadly to health and well-being suggest future challenges ahead. Significant environmental trends highlight the increasing impacts of human activity on the natural world and how those impacts are in turn exacting a greater toll on society. Social trends of inequality in health and wealth have increased steadily over time. Within healthcare and health outcomes, inequality in the U.S. is growing while health outcomes are worsening, even as health expenditures continue to grow rapidly.

Some trends do, however, offer hope. Continued innovation in technology and healthcare continues to expand possibilities for interventions and treatments. Social trends point to a rising generation that is more diverse, more inclined to address collective issues, and that is more aware of environmental challenges. Overall incomes and economic growth are beginning to increase again after the Great Recession (but signs are pointing to a potential slow down), and incarceration rates are beginning to decline.

Key Directions of Change

- Deepening and increasing human impact on the natural environment
- Increasing economic and income headwinds due to population aging, disruption from technology and global trade frictions
- Widening inequalities in wealth and health
- Worsening health indicators and an unequal burden of disease
- Increasingly diverse and gradually more liberal population.

Anticipating Change

Looking beyond the trends that indicate the current direction of change, there are disruptive technologies, policy issues, and ideas emerging that could shape the futures of health and well-being. These represent *possibilities* for new developments; none are guaranteed to emerge. They identify potential risks before they become actual threats, as well as potential opportunities to nurture and shape into positive realities.

Sifting through the weak signals of change in today's environment, the short to mid-term horizon features possibilities from people grappling with the impacts of major systemic trends, such as climate change, the environment and resources, lifestyle and demographics, and the digitization of society. Looking to the long-term horizon, the emerging potential for deep, even devastating, disruption to traditional institutions and the environment: powerful technological capabilities diffused across both human populations and potentially even to novel actors like intelligent machines. The unleashing of such changes could quickly outpace human control and comprehension.

Examples of Emerging Issues and Disruptive Combinations

- *Increasingly Extreme US Political Swings:* Political dysfunction worsens as the swing between Republican and Democratic administrations creates ever-more-extreme polarization.
- *Machine Charities:* Smart technologies could give rise to 'machine charities' where networks of AI-powered devices generate money and make donations to the most effective charities, or even make microloans directly.
- *Redefining Childbearing:* Exo-wombs could change traditional structures and presumptions around childbearing.
- *Kids Curing Kids:* Advances in DIY synthetic biology could enable just about anyone to design and produce their own biologic and genetic treatments.
- *Vegetarian Pandemic:* Eco-terrorist biohackers could engineer a synthetic microbe that creates a meat allergy.
- *Norton for Minds:* The market explodes for expert-trained mental health software programs that learn their users and provide constant, deeply personalized support.

Key Considerations and Uncertainties for the Future

While trends and emerging issues suggest possibilities for the future, significant uncertainty always remains about what will come next. Any effective exploration of

the future generates a number of questions and concerns, as new issues are discovered, and old assumptions are tested.

Considerations Arising from the Futures Scanning:

- What are long-term individual and collective impacts of rising levels of complexity and stress in daily lives on future health?
- How much will people come to accept machine assistance (i.e. AI) in handling this ever-increasing complexity and stress of daily life?
- If social and economic disparities continue to widen within society, what might be the *Occupy*, *#MeToo*, and "Make America Great Again" movements of the future?
- Many people don't share common truths anymore and many can no longer hear truth from one another; what pathways might people build to restore civil discourse and compromise?
- While diversity can be critical to things like resilience and innovation, it can make creating shared visions and narratives challenging.
- How well will the U.S. navigate the demographic and cultural shift to a no-ethnic-majority society?
- What might emerge as the next set of hero archetypes in U.S. society?

Strategic Uncertainties about the Futures of Health and Well-being:

While there are innumerable uncertainties about the future to be considered, the following are just a few of the important structural issues on which the future could pivot.

- Exactly how much disruption will be introduced by automation and AI?
- How successful will niche social and economic innovations and start-ups be in creating systemic change across health and well-being?
- How effective and widespread will genetic approaches to health be?
- Will U.S. society begin to overcome its structural issues with race, and if so, when?
- Will the U.S. wealth gap begin to close, as in past periods of history, and if so, when?
- How quickly will federal politics swing back Democratic, and how extreme will that swing be?
- What will be the pace and severity of impacts of the climate crisis?

Based on the research conducted through this futures scan, the U.S. has entered a period of increasing complexity and stress. Trends and emerging issues suggest this period will witness worsening inequalities (e.g. wealth, income, and housing) and deteriorating health outcomes (such as lifestyle diseases, maternal mortality, mental health, and

lifespans), combined with increasing environmental hardships. These changes are occurring just as the country begins a significant generational shift towards increasing diversity and liberalism, rising secularism, and changing life stages, compounded by rapid technological change.

This period of turbulence could result in the U.S. "locking in" its current trajectories of inequity and inequality, squandering the chance of dramatically improving health through transformative new healthcare and new social arrangements. It also suggests emerging opportunities. For example, a new generation concerned with inclusion and sustainability, wielding powerful new tools, could introduce new solutions to the challenges surrounding health and equity.

During this period of turbulence and transition – when rules will be rewritten and new systems created – there will be a greater than normal ability to influence and shape what is to come. The challenge will be to take action with forethought and perseverance, even as many other stakeholders feel empowered and emboldened to make their own marks on the future.

Contents

Introduction

FORESIGHT is an initiative of The Rippel Foundation, created in partnership with Blue Shield of California Foundation, and actively supported by forward-thinking national and regional philanthropic partners. It is a visionary futures learning journey that will involve thousands of Americans in reconceptualizing health and redesigning systems to enable lives of health and well-being throughout the United States.

The FORESIGHT initiative challenges participants to re-envision the U.S.'s landscape for health, care, and well-being, given that today's systems and solutions as "designed for another time … one that no longer exists." Those systems are inadequate in the face of current health problems. As system structure produces system behavior, incremental fixes and minor adjustments will simply not create meaningful and lasting change. System re-imagining – from the ground up - is required to support lives of health and well-being. Doing the same things better will NOT solve current health challenges.

In conditions of dynamic, fast-moving, and transformational change, only bold new strategies and solutions will advance health and well-being. Collaborative foresight and community dialogue are central to this effort. FORESIGHT has partnered with futures researchers, designers, community facilitators and members—especially those who are currently and historically marginalized—and others to support the long-term visioning and action needed for real change. The effort will connect over-arching global and national changes, policies, and initiatives, and ultimately result in community and regional action that advances new visions of health and well-being.

Exploring the Future of Health and Well-being

Health and well-being are, in some sense, affected by everything in a person's life. A truly comprehensive assessment of every variable that might shape the future of U.S. health and well-being would be a monumental project. This exploration is necessarily smaller, while still trying to look across a wide landscape. This effort focusses on how the broader socioeconomic, technological, and cultural context for health and well-being may change, rather than looking at specific futures for medicine and healthcare per se.

This study explores changes relevant to health and well-being through multiple methods and lenses drawn from futures studies. It builds on Vision Foresight Strategy's (VFS) previous scan of scans, which reviewed what changes other health foresight research identified as important. From that starting point, the VFS team has: 1) identified historical patterns of change relevant to health and well-being in the U.S.; 2) inventoried key trends characterizing the US context today; 3) forecast how those trends might evolve; and 4) identified emerging signals of change via wide-ranging scanning research. This scanning research particularly looked for change in eight important topic areas:

- Equity
- Economics
- Climate change
- Demographic shifts
- Technology
- Culture shifts
- Social contract
- Healthcare system

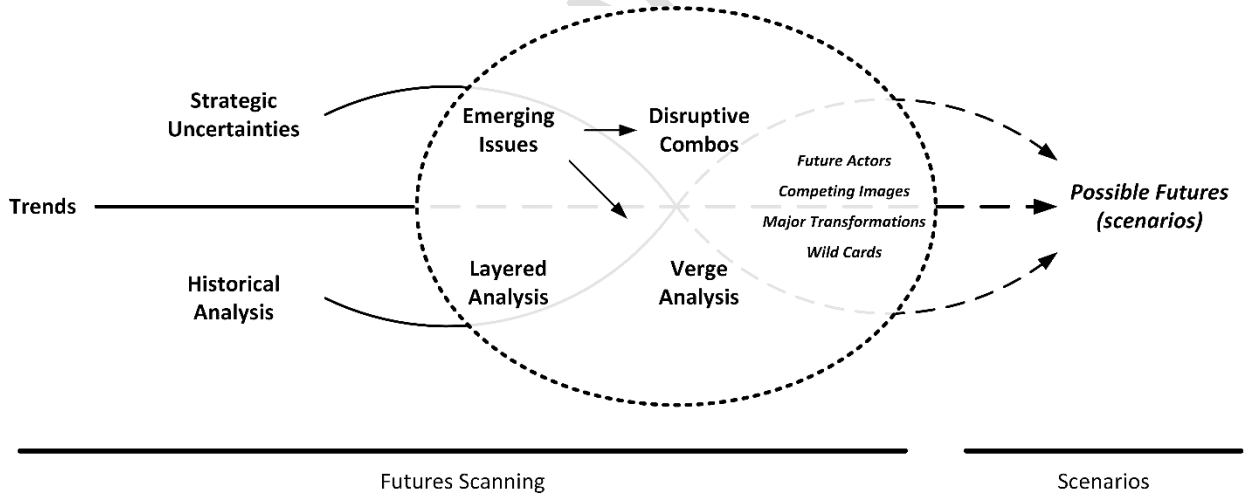


Figure 1: The Futures Scanning flow

The narrative arc of this report begins with a critical review of past events significant to health and well-being in the U.S. It then examines what is currently changing and what might evolve. This prepares the ground for an informed dialogue about strategic directions and possible actions to create a better future for health and well-being in the U.S.

Futures of Daunting Challenges and Transformative Potential

Based on this Futures Scanning effort, the U.S. has passed into a period of considerable – and increasing – turbulence, created by the overlap and intersection of multiple types of change. This period of intense change offers a near-miraculous potential for well-being that, in some cases, could be undercut by deep structures of U.S. history and by the dismaying direction of many current trends and developments. Navigating this transition and ensuring a more desirable future will require new visions and new forms of collective, sustained action.

On the horizon there are a number of major shifts in society promise to be strategic and disruptive in their impacts. Increasing environmental crises could result in increased public health crises; technological innovations could offer extraordinary capacity to observe and analyze ourselves and our environment and to alter them both; and the most diverse generation this country has ever seen will mature as health consumers. The U.S. will need to navigate this confluence of environmental, systemic, and cultural transformations.

This turbulent context will bring uncertainty, anxiety, and overreaction, as well as hope, opportunity, and innovation. Some of the more strategic transformations, which are already underway, include:

- *Geopolitical landscape:* power, influence, and preferences for the future are shifting dramatically on the global stage. The U.S.'s position and stature in the world is changing, and the assumptions and diplomatic ties that bind the peoples and economies of the world are loosening. The implications for the U.S. economy, optimism, and worldview are considerable.
- *Climate crisis:* as the world's climate changes, sea levels are rising, temperatures are rising, ecosystems are shifting, and devastating extreme weather is increasing in frequency and severity. The impacts on well-being are direct, indirect, and multiplying. The risks to homes and communities, increasing health and disease risks, and the effects on agriculture, fishing, and food supply chains are just some of the more obvious implications. As more economies mature, accelerated resource consumption will amplify the climate crisis, while adding to health risks by adding more toxins and pollutants to the environment.
- *Cultural:* the demographic landscape of the United States is evolving from a 20th C demographic profile composed primarily of migrants from Europe, to a 21st C national demographic profile composed of migrants from all over the world. Increased cultural diversity arising from this demographic transition will increase the range of perspectives and values arising in public debate. With younger and more diverse generations moving towards political significance in the mid to long-term, the U.S. has already begun a potentially historic shift in its popular and political culture - a possible shift towards greater tolerance and inclusiveness.

- *Machines:* one of the most talked about potential transformations arises from accelerating innovations in areas such as computing, robotics, and machine intelligence. New forms of automation, increasingly connected devices (the Internet of Things), and more capable machine-controlled devices are proliferating. In the not-too-distant future, ecosystems of machines may evolve and come to structure, guide, and constrain our daily lives in ways too varied and complex for us to understand.
- *Biology:* biotechnology, ranging from genetic therapies to cutting-edge synthetic organisms, has greater potential to transform society than even machines. Researchers are using engineered lifeforms to produce goods and energy; are tweaking species genetically such that they pass their new characteristics on to their offspring; and are creating entirely new lifeforms from scratch. The profound risks and potentials in being able to precisely and consistently modify life on Earth, from the microscopic to the macro, cannot be understated.

These and other important environmental and societal shifts are underway right now. This report details a range of the historical dynamics, current trends, emerging issues, and additional considerations that play into their development. These changes pose threats to futures of greater well-being as well as presenting positive opportunities for them. A sampling of these includes:

Threats and Challenging Issues	Opportunities and Inspiring Possibilities
Accelerating biodiversity loss	Declining rates of incarceration
Falling life expectancy	Increasingly diverse population
Worsening maternal mortality	Accelerating medical innovation
Ballooning student debt	Autonomous Pervasive Healthcare
Widening income and wealth gaps	Redefining Childbearing
Ready Player, Escape	Editing Out Addiction
Runaway Microbial Tribbles	Norton for Minds

While the future always features competing trends and clashing preferences, few previous periods in history have featured so many profoundly transformative shifts occurring at the same time and occurring at so many different scales. Society is simultaneously facing issues like increasing microbial resistance to antibiotics, teenagers able to engineer new lifeforms, the world's economic and innovation center of gravity shifting east towards China, and the climate crisis threatening food supply chains while thawing the permafrost and releasing ancient pathogens and deadly toxins.

Occurring at different levels, these transitions interact, creating entirely new stresses on individuals and communities, and kicking off entirely new changes in the process. This

could pose issues like accelerating technological change exacerbating an already overloaded capacity to adapt, while demographic shifts fuel a fight over innovation and the architecture of society.

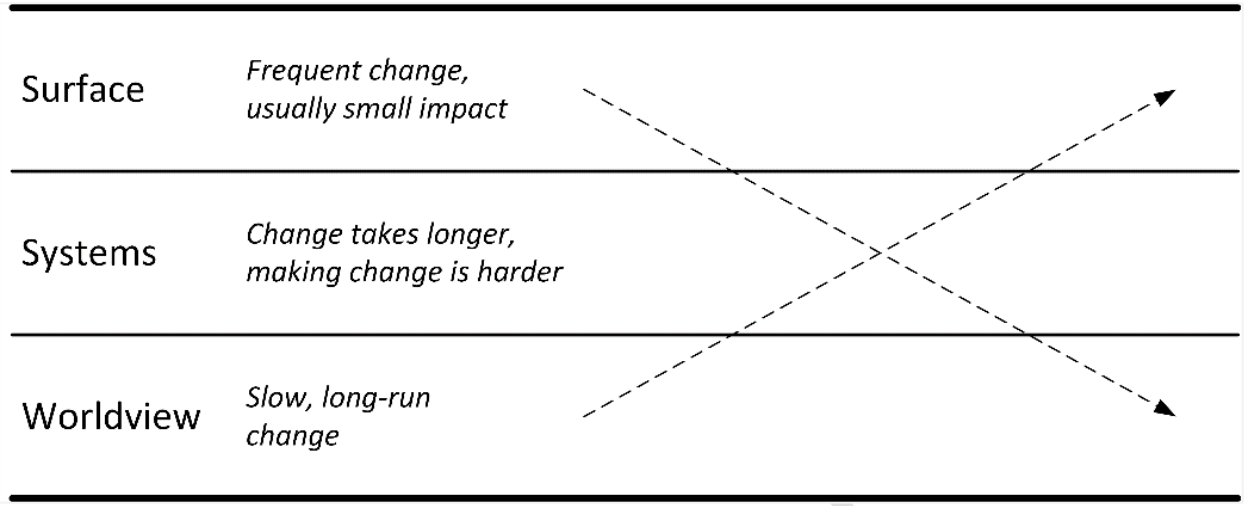


Figure 2: Layers of interacting change

Great uncertainty surrounds which of these changes and possibilities might create the greatest impacts and which of them might define our future the most. This study raises concerns about who is developing the technologies and polices of the future. Society is rapidly digitizing; the infrastructure and operating norms of the future are in large part being built by actors for whom the general health and well-being of U.S. communities is often a second-tier interest, at best. Globally and domestically, contests are underway between using these powerful new technologies to centralize control and using them to decentralize power and resources. These contests pertain to the futures of health as much as they do to the futures of social media and entertainment.

Historically, social movements and federal government action have been at least as important as scientific advancements in shaping the conditions for health. Indeed, they have been important counters to impacts from the unintended, systemic ill-effects of free-market capitalism, and the ebb and flow of urbanization and demographic change. The current era of political party polarization and legislative stalemates hobbles effective federal action to enhance health and well-being in the U.S.

Specific threats and opportunities for health and well-being aside, there is a possibility that current trajectories of inequity and inequality will get locked in. Amazing possibilities for strengthening communities, access to material affluence,

and transformative medicine are on the horizon. These possibilities, however, are unlikely to realize their full potential – or in some cases, emerge at all – without successful initiatives to overcome the substantial barriers to systemic, innovative change.

At the same time, the magnitude of the changes and major transformations described in this report suggest fundamental changes that could render moot current assumptions and practices. Along with the immense barriers to systemic change, truly strategic shifts confront us. Fixating on and debating about how to trim one tree while the entire forest rapidly becomes grassland will only put health and well-being further at risk.

The urgency and breadth of the major issues that could impact U.S. health and well-being could outstrip individual capacity for adaptation as well as current, collective incentives for action. Looking ahead, adaptation and solutions may be possible, but will require conscious and sustained efforts to cultivate and implement. Given the negative trends underway and the structural impediments, it is unlikely that positive, systemic change will occur without concerted and informed action.

There is, fortunately, much light on the horizon. New technologies, new ideas, and new social movements offer significant potential for dramatically improving health and well-being in the U.S., but only if their potential can be unleashed.

Futures Research, Foresight, and Scanning

The approach behind this report is informed by the field of *futures studies*. An often-misunderstood academic field, futures studies is fundamentally concerned with trying to understand and anticipate change in society, and then use that foresight to help organizations better anticipate and take advantage of change. To produce foresight, futures relies on a variety of research concepts and methods. One of the most fundamental activities of futures research, and the focus of this report, is *horizon scanning*.

The world is constantly changing. Some of that change is slow moving, incremental, and persistent; other change is sudden and deeply disruptive. Changes like community demographics are relatively slow-moving and easy to track and anticipate; other changes, like the seemingly abrupt emergence of radical new technologies, surprise us with unexpected turns. To adapt successfully or innovate effectively, it is critical to notice broad environmental change.

Horizon scanning is designed to identify potentially significant change and to monitor its emergence as it matures from fringe idea to mainstream reality. The most effective scanning identifies emerging change in sufficient time to create contingency plans to make the best of the opportunities that changes present and to address potential harm that they may produce. Horizon scanning is thus one of the activities within future studies that is intended to help develop *foresight* – insight into how and why the future may be different from the present.

Figure 1, on the next page, depicts the (generic) life cycle of change, from "emerging issue" to an accepted part of everyday life, both in terms of the number of observable cases and in terms of public awareness. The growth of any emerging issue into a mature phenomenon follows this typical s-curve, provided the emerging issue does actually evolve into a full-blown trend, instead of dissipating and disappearing.

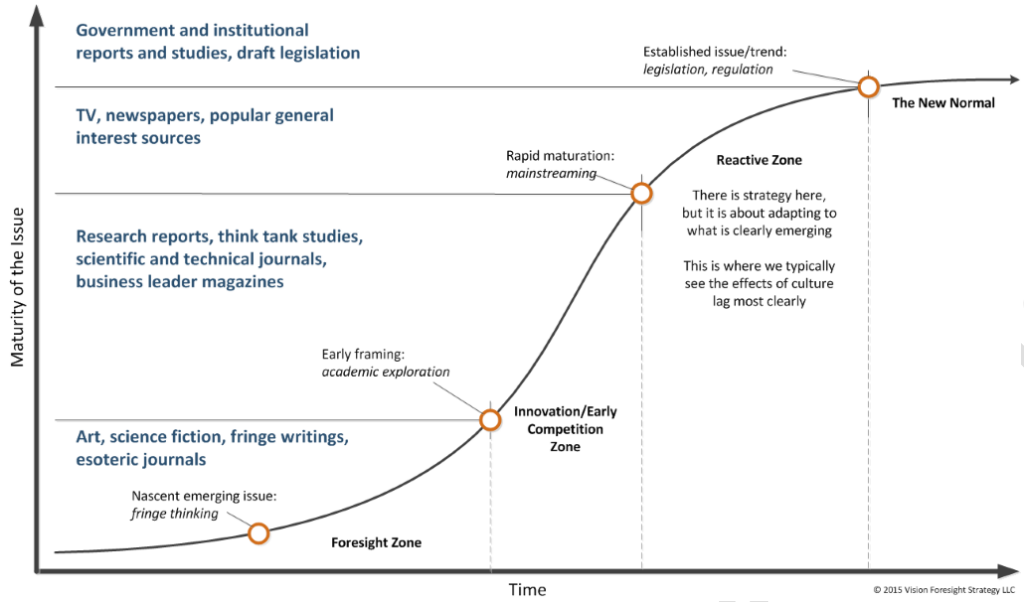


Figure 1: Life cycle of change: model for scanning and spotting change

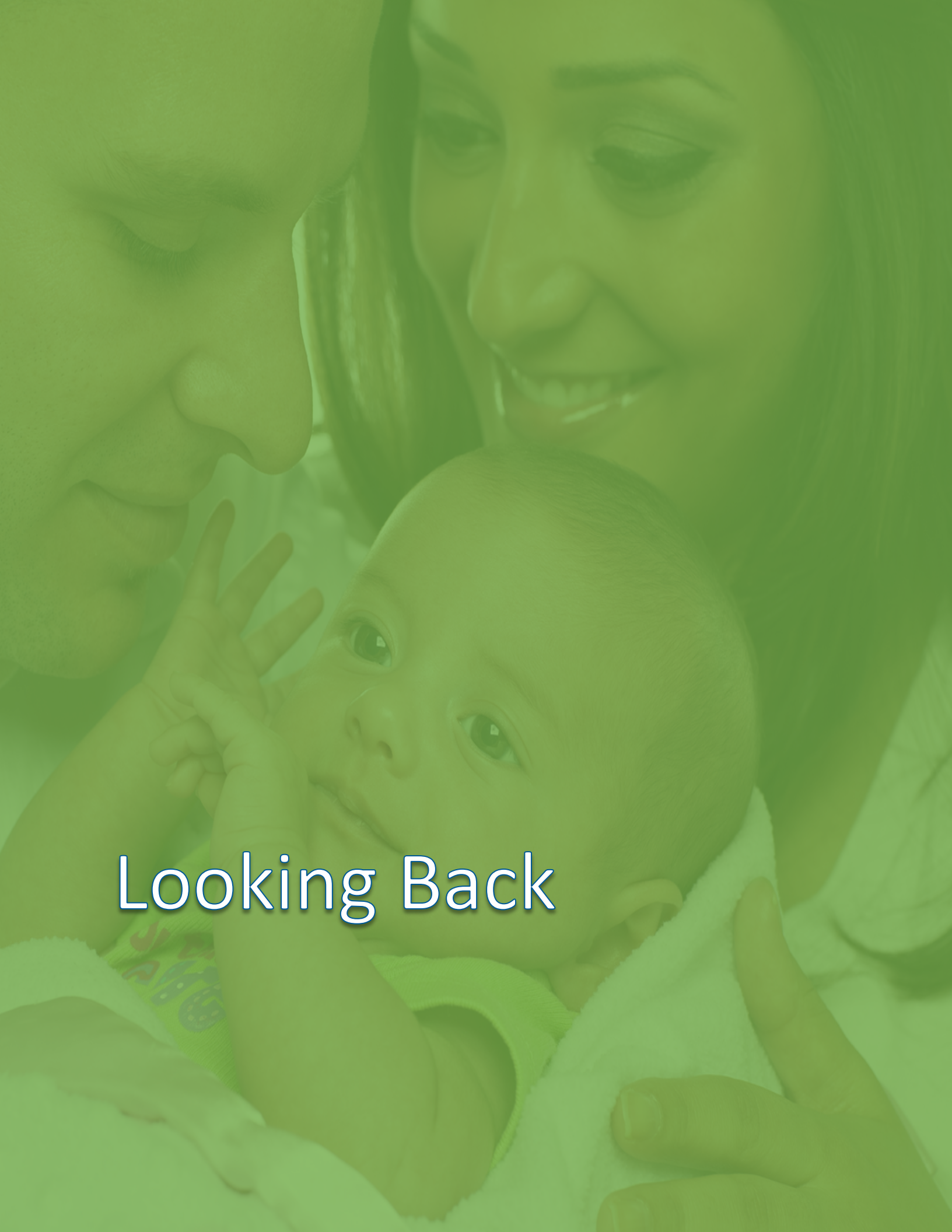
Note that perceiving weak signals of change requires monitoring publications and activities on the far lower left end of the curve: specialist and fringe publications, blogs, conferences, media output. A robust scanning strategy will monitor change all along this curve and discriminate between the uses and usefulness of data emerging from different points of the curve. As a change matures, more and more data points are available with which to analyze it. Change is a variable that displays a trend in some direction, and that has growing statistical significance. When a change is just emerging, and only a few data points exist with which to characterize it, one can only analyze it via a case study approach.

An additional goal of comprehensive horizon scanning is discovering change emerging *outside* normal frames of reference. Thus, scanners must guard against in-built sources of bias in either source identification, taxonomic structure, evaluative processes, or validation criteria. Horizon scanning should function to address human, community, and organizational blind spots and assumptions about change and the range of possibilities for the future.

How This Report is Organized

The document is divided into six key sections that collectively provide the reader with interim results from the scanning research identifying trends and emerging issues. The report also includes a glossary and appendices that list raw scan data, wildcards and expanded historical timelines.

- **Introduction**: introduces the context on the project and the approach. *Read this section if you most want to understand the conceptual underpinnings of the project, and the methods used.*
- **Looking Back**: summarizes VFS's, FORESIGHT futurists consultants, regarding historical patterns that created present conditions, including historical timelines, key constants, and trends. *Read this section if you are most interested in precursor patterns of change.*
- **Anticipating Future Change**: offers extrapolations forecasting how current trends might evolve in future; also identifies emerging signals of change and how they could combine to disruptive effect. *Read this section if you are most interested in emerging changes that might affect the futures of health and well-being.*
- **Exploring Broader Interactions:** begins to analyze the relationships between trends and emerging issues and where their impacts might fall first. *Read this section if you are most interested in how changes will affect systems, values, and stakeholders.*
- **Additional Building Blocks for Futures:** presents competing images of the future of health and well-being, key uncertainties, and potential wild cards for futures of health and well-being. *Read this section if you are most interested in exploring more building blocks for imagining alternative future outcomes.*
- **Conclusions**: summarizes critical patterns of change; highlights those with high potential for disruption or transformation; and suggests how the overall scanning work will contribute to the next steps of the project. *Read this section if you are most interested in how this scan fits into the ongoing activities of the FORESIGHT project.*
- **Glossary***:* key terms in foresight and futures research used in this report. *Refer to this section for definitions and explanations of futures concepts and methods.*
- **Appendices**: how this report was researched. *Read this section if you most want to understand strategies for source collection, data harvesting, and initial categorization.*



Looking Back

All good futures research begins with solid historical research and analysis. As a context for people's perceptions of change, it is also useful to inventory what key actors and stakeholders consider to be the historical events, watersheds, and dynamics most relevant to their issue of interest. To frame our futures scanning efforts, VFS facilitated several conversations with the FORESIGHT participants and Philanthropic Partners about relevant historical changes post-1950. These conversations enabled VFS to map the patterns of past events that contributed to the current context for health and well-being. Please note that the charts displayed in this section begin an analysis in 1950 and do not reflect actions and policies as the U.S. was founded such as colonization, native relocation and genocide, slavery and the many implications on health and well-being the followed and still persist.

Historical Analysis

The health and well-being of the U.S. population was impacted by just about every transformation and turning point in history. Focusing our view, one might see the history of health and well-being as one of a set of relatively rapid social and economic shifts, including:

- The rise of science and industrialization across medicine, food, and public policy;
- A shift from a rural, agricultural society to an urban and industrialized one;
- The rise to dominance of one approach to medicine among many competing philosophies;
- The gradual, if not grudging, connecting of a broad patchwork of mostly private "healthcare" institutions and systems;
- The professionalization of medicine and the commercialization of healthcare;
- The rapid despoiling of the natural environment and the industrialization of our food systems.

In short, in a relatively brief period of time, the U.S. has undergone dramatic changes in its physical environment, in lifestyles, and in notions of health and medicine, while concurrently becoming more entrenched in policies, practices, and systems that produce inequities and health disparities. In retrospect, given the pace and character of this change, it is not surprising that people have come to experience a broad array of illness, dysfunction, and disparity. From a historical perspective, the lives people lead today are in many respects very *unusual* compared to the past. With accelerating technological change, things in the future may become even more dramatically unusual.

Historical Drivers of Change in Health and Well-being

When attempting to identify specific drivers of change in U.S. health and well-being over the past seventy years, several stand out, including:

- *Federal policy:* The importance of federal policy in seeking to establish conditions for equality, while simultaneously, enacting and maintaining federal policy, practices, and systems that have resulted in inequity and racist systems that regularly disadvantage some while advantaging others. (For a definition of "racist" see Emerging Issue #35.)
- *Political narratives:* How dueling political parties, and the narratives they craft, frame policy and shape U.S. discourse and assumptions (e.g. the Johnson era with its Great Society and "war on poverty" programs, or the Reagan era with its supply-side economics and War on Drugs.
- *Social movements:* Like broad political narratives, social movements have significantly affected both the societal conditions for health and well-being, and the policies and practices specifically aimed at health. The environmental, civil rights, and women's rights movements are prominent examples.
- *Medical technology*: U.S. culture is largely enthusiastic about technological advancement, and Americans can expect continued technological innovations to improve health.
- *Food industry*: Commercial food supplies and retailers have strong incentives to improve profits and continually expand market share and this has contributed significantly to the mass marketing of cheap and unhealthy food and food fads built on the "latest, greatest" foods and diets.
- *Globalization and free trade*: the integration of the world's economies has deeply affected U.S. economic structures, with the loss of manufacturing jobs being one of the most obvious outcomes. Major patterns of employment have shifted, the impacts of which ripple across family life, community structure, and education.

Events that Shaped U.S. Health and Well-being

The summary graphic below highlights key recurring cycles of change, historical drivers, and pivotal events identified during our discussions of history. While this report shows timelines beginning in the 1950s, FORESIGHT's partners and participants acknowledged and included earlier, critical timeline elements that significantly impact U.S. health and well-being. Among others, these included colonization, taking of native nation lands, relocation and genocide of native peoples under the Federal Relocation Act, and abducting, enslaving, and exploiting Africans in economies, systems, and practices that historically and currently disadvantage them and have had catastrophic effects on their health and well-being. These, along with other critical early events in U.S. history, have had an impact on health and well-being of all

Americans. Some of the critical events – post 1950 – are provided below with additional timelines in Appendix D:

1.

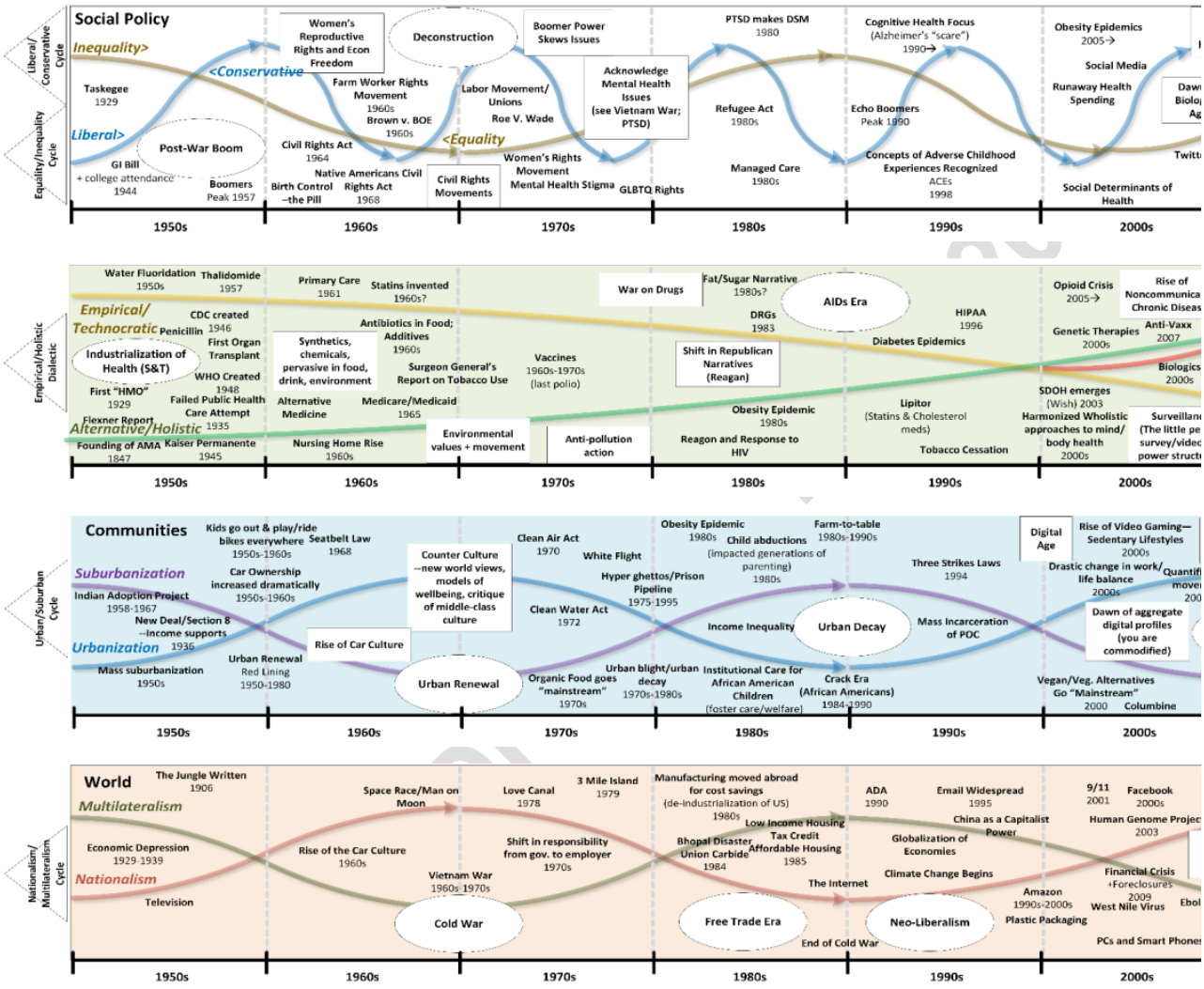


Figure 3: A timeline of some of the changes relevant to health and well-being in the U.S post-1950.

These insights about historical dynamics and drivers of change, as illustrated by pivotal events, will contribute to future patterns of change analysis.

Re-occurring Cycles

The following examples of cycles in U.S. history have had important indirect impacts on the health and well-being:

- *Equality/Inequality Cycle*: The country's socioeconomic and political landscape tends to move through periods of greater equality or greater inequality.
- *Liberal/Conservative Cycle*: The country's political and cultural landscape tends to shift back and forth between liberal and conservative ideologies, usually manifested in presidential elections.
- *Interchange between Empirical/Technocratic and Alternative/Holistic Views of Medicine*: A very long-term interaction (dialectic) between an empirical approach to medicine and a more holistic approach that treats the whole person.
- *Urban/Suburban Cycle*: The movement of populations back and forth between urban centers and suburban areas in response to changes in demographics, economics, policies, and cultural values
- *Multilateralism/Nationalism Cycle*: At the international level, the US tends to oscillate between multilateralism (a respect for allies and international institutions) and nationalism (US above all else). A similar oscillation occurs at the national level between greater or lesser openness to immigration and trade.

Key Constants

Good scenario forecasting includes "key constants." These are deep-rooted realities that will barely change in the next thirty years no matter what forces affect the system. Continuity is an important characteristic of life; as a scenario building block, it helps forecasters think critically about how stakeholders and systems might respond to or even inhibit dramatic change. During discussions with the FORESIGHT Project team, VFS collected an initial list of key constants that could contribute to the scenario development process:

- Mortality
- Reproduction (offspring) will continue to be part of life
- Hierarchy of needs for survival will not change (water, food, shelter, company)
- People will continue to get sick
- Capitalism (in some form) will continue
- Humanity will continue to fight wars
- Migrations will continue, although the destinations and demographics will change
- Patterns of racism, marginalization, and privilege will continue due to both personal biases and behaviors as well as systemic and marginalizing policies and practices

- Self-serving and self-interested behaviors will continue to motivate many in society
- Social classes will continue in some form as a structure of society
- Charitable impulses and altruism will still be inherent in humanity
- Human inventiveness will continue

Note: This list is illustrative, not exhaustive.

Trends: The Momentum of Past Change

Two of the most fundamental building blocks in foresight work are trends and emerging issues. Of the two, trends have traditionally been used the most to help people think about the future. Trends are descriptions of history: they describe change that has already occurred. Examples of trends include the shrinking middle class, and the rising cost of a barrel of oil. Trends are critical building blocks of foresight because they tell us about the current directions of change.

Horizon scanning generates the building blocks for rigorous foresight work. One of the first steps in good scanning is taking stock of the current, critical directions of change. VFS drew on prior literature reviews, the historical analysis of the preceding section, and additional research to identify and describe some of the trends that are important for understanding the present and exploring the futures of health and well-being in the United States.

The Broader Environment

1. Accelerating Biodiversity Loss
2. Climate Change is Becoming Increasingly Costly
3. Spreading Microbial Resistance

Societal Trends

4. The U.S.is Becoming Less Geographically Mobile
5. The U.S.'s Changing Cultural Values
6. Incarceration Nation on the Decline
7. Income and Wealth Gaps Continue to Widen
8. Increasingly Vulnerable but Still Growing Coastal Populations
9. Life Stages Shifting Older and Out of Order
10. Rising Costs of Living are Gentrifying the Nation's Cities
11. Deepening Battle Over Vaccines
12. The U.S.is Becoming Increasingly Diverse

13. The U.S.'s Shifting Faith Landscape
14. Ballooning Student Debt
15. Runaway Healthcare Spending

Health and Healthcare Trends

16. Falling Life Expectancy
17. Worsening Maternal Mortality in the U.S.
18. Unequal Burden of Disease
19. Growing Rates of Anxiety, Depression, and Suicide
20. Medical/Health Innovation is Accelerating
21. Healthcare Becoming Increasingly Digital and Distributed
22. Expanding Health Deserts and the Urban/Rural Divide

The trends concerning the Broader Environment show how the natural world is increasingly impacted by human activity and how those impacts are now having a greater toll on society. Among the Societal Trends, progress has been made regarding increasing overall incomes and economic growth and the beginning of a decline in incarceration rates. Other trends, however, indicate that inequalities in health and wealth have been steadily increasing over time. A final group of societal trends point to a rising generation that is more diverse, more liberal in social values, and more aware of environmental challenges. The Health and Healthcare Trends show U.S. inequality in particularly stark detail regarding health outcomes, but also suggest that technology is creating new possibilities for healthcare.

These trends are described in detail in the following pages.

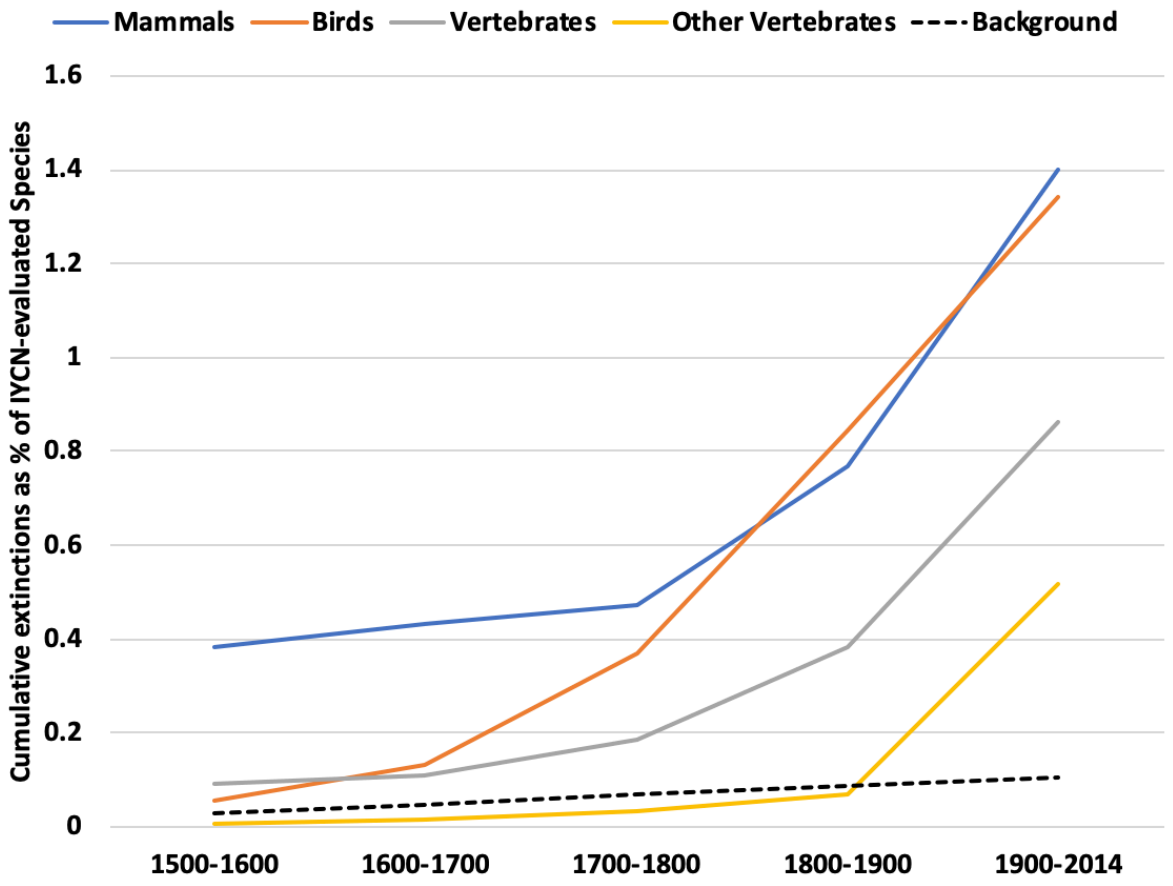
1. Accelerating Biodiversity Loss

Human activity around the world is pushing an increasing number of species toward extinction with significant ramifications for human health, including undermining food security and clean water.

Topic Area:	Climate Change
Trend Drivers:	Rising standards of living (leading to increasing per capita consumption of natural resources); habitat destruction and fragmentation through the growth of urban areas and infrastructure networks; climate change; persistent demand for endangered-species-based products
Nature of the Trend:	Increasing, exponential trend
Description:	Humanity's impact on the natural world is growing as more people move into higher-consumption lifestyles, resulting in an accelerating global loss of biodiversity. Estimates suggest most land habitats have now lost 20% of their biodiversity, with the majority of that loss occurring after 1900. 85% of all habitats on Earth are now adversely impacted by human activity. A new UN report found that as many as 1 million plant and animal species are now at risk of extinction due primarily to four trends: • Habitat loss driven by logging / farming, expanding urban infrastructure, and the draining of wetlands • Direct over-exploitation, for example by fishing and poaching • Pollution • The transport of invasive species Climate change would further amplify biodiversity loss—an estimated 5% of species worldwide would face extinction in a 2°C warmer world. Biodiversity loss has important ramifications for human health as well as the health of the natural world. The loss of pollinators and decline of soil health has a direct impact on food security. Rainforests and coral reefs are sources of important new medicines. Wetlands and mangroves protect us from storms and help clean our water. In all, trillions of dollars of ecosystem services are increasingly at risk. Biodiversity loss is forecast to

accelerate between now and 2050, particularly in the tropics, pushed by additional population growth and rising standards of living there.

Trend Graphic:



*Species lost to extinction compared to expected background rate, 1500 to 2014**

***Note**: the background extinction rate represents the natural rate of extinctions with no human presence— even back in the 1500s (and before), humans were having an adverse impact on biodiversity*

Source:

Ceballos, Greardo et al. 2015. "Accelerated Modern Human-Induced Species Losses: Entering the Sixth Mass Extinction." Science Advances 19
https://advances.sciencemag.org/content/1/5/e1400253/tab-figures-data

Potential Downstream EIs in this Report: "Birthstrike"; "Solving Waste Inequity"

Things to Consider

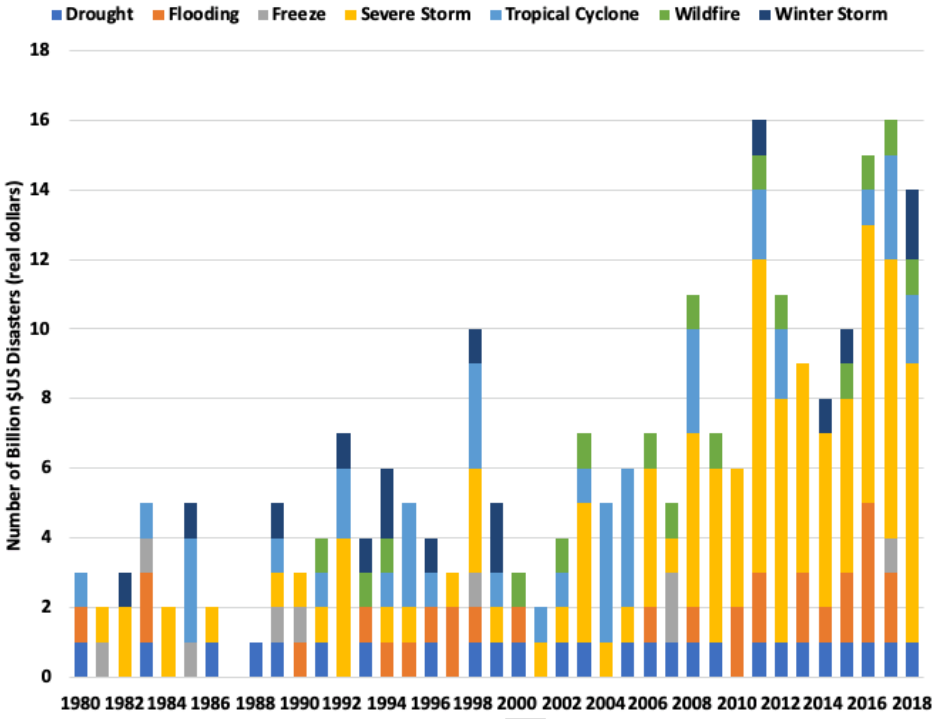
Is there a tipping point for biodiversity loss beyond which an ecosystem cannot recover? Is it possible to restore an ecosystem once it has collapsed? Can human society achieve economic growth without damaging the natural world? How will new technologies like additive manufacturing change our environmental footprint?

2. Climate Change is Becoming Increasingly Costly

The number and cost of climate-driven weather disasters is increasing, straining the U.S.'s ability to cope.

Topic Area:	Climate Change
Trend Drivers:	Greenhouse gas emissions; population movements to coastal cities and into more vulnerable areas (flood plains, western forests, etc.); aging infrastructure
Nature of the Trend:	Increasing, exponential
Description:	The number and cost of weather-related disasters is increasing rapidly in the U.S. and around the world as the planet grows warmer, more crowded, and more developed. From 1980 to 2000, the U.S. experienced an annual average of 3.9 weather-related disasters that cost the country more than $1 billion dollars. From 2000 to 2010, the average jumped to 8.5 per year, and again to 11.6 per year for the 2010 to 2018 period. The five costliest years for the U.S. have now all occurred since 2010. The type of weather-related disasters has also shifted over time. From 1980 to 2000, winter storms and freezes accounted for 20% of all billion-dollar events. But from 2000 to 2018, these same disasters accounted for just 5%, even as the total number of billion-dollar events has grown from 82 to 162 over the respective time periods.

Trend Graphic:



Number of Billion Dollar Disasters in the US by Type (real dollars), 1980 to 2018

Source:

NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2019) https://www.ncdc.noaa.gov/billions/

Potential Downstream EIs in this Report: "Climate Refugees and Adaptation"; "Climate Crisis Impacts Health of Most Vulnerable"; "Disparities of Climate Crisis Impacts on Food"; "Birthstrike"; "Solving Waste Inequity"

Things to Consider

Natural disasters and weather make headlines, but how much will climate change's other impacts, like population displacement, loss of biodiversity and habitats, and the spread of disease, cost the economy? At what point does the cost of natural disasters become too great and people begin to permanently relocate from vulnerable areas?

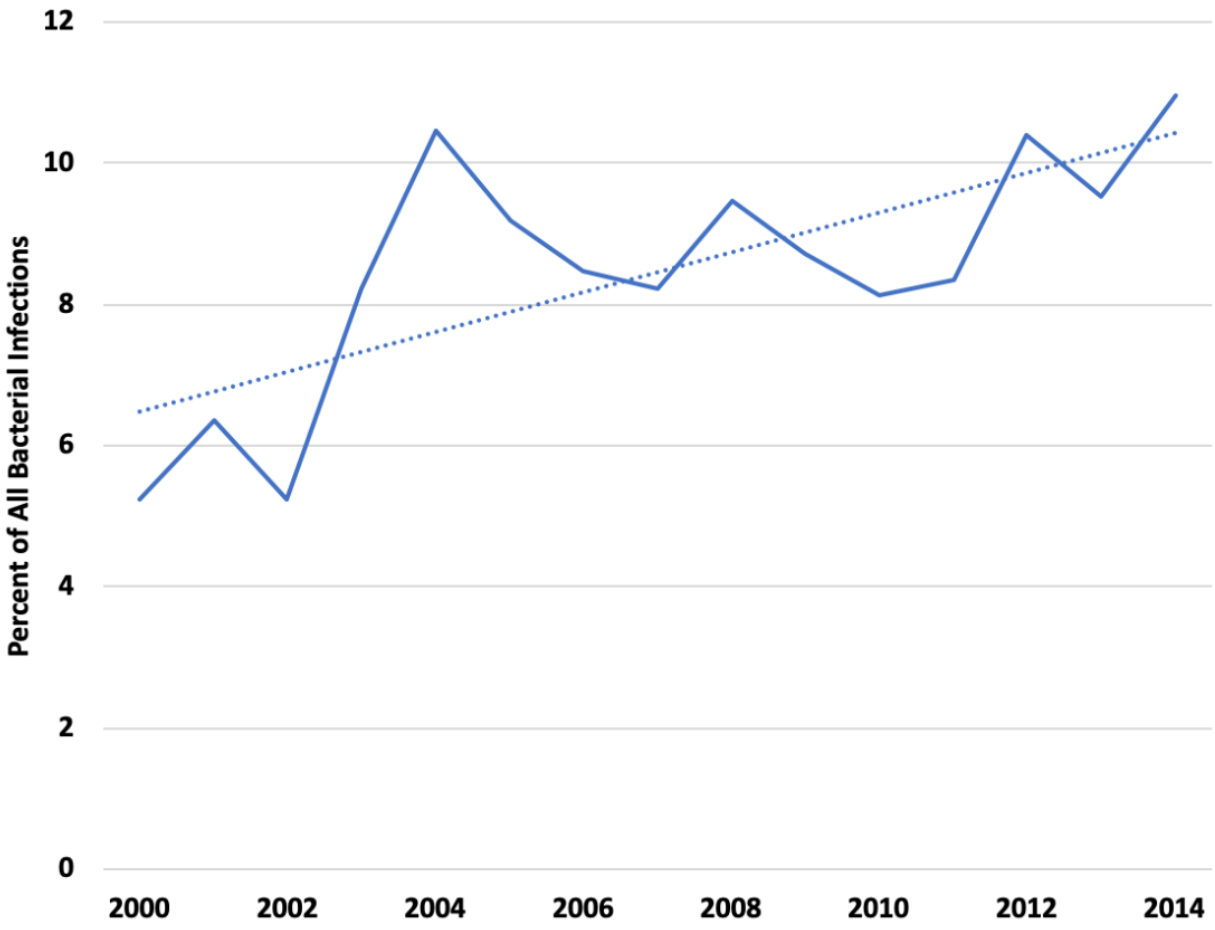
3. Spreading Microbial Resistance

Disease-causing bacteria and fungi are growing resistant to an ever-wider array of antibiotics and antifungals, threatening to undermine many gains of modern medicine even as research into new treatments is lagging.

Topic Area:	Healthcare System
Trend Drivers:	Overuse and misuse of antibiotics—particularly in the agricultural sector; Increasing use of antibiotics in the developing world; market forces within the healthcare system don't incentivize antibiotic development; slow pace of R&D into new treatments
Nature of the Trend:	Rapid, increasing linear trend
Description:	Antibiotics are one of the greatest life-saving inventions in human history. But their effectiveness is being increasingly undermined through overuse and misuse. Multiple-antibiotic-resistant microbes are becoming more common in hospitals, nursing homes, and other healthcare facilities as well as among the general population, threatening many of the public health gains made over the last century. In the U.S., the number of antibiotic-resistant infections more than doubled between 2002 (700,000 infections or 5.2% of all bacterial infections) and 2014 (1.6 million or 11% of all bacterial infections). They now number around 2 million per year, causing 23,000 deaths. Antibiotic-resistant infections now cost the country more than $2 billion dollars annually in direct health costs for inpatient care alone. Overuse of antibiotics is the primary driver of resistance. Globally, use of antibiotics has surged more than 65% since 2000. Growth prior to 2000 was driven mostly by use in high-income countries, especially the U.S.—now beginning to see a decline in use - and also France and Italy. Most of the growth today is now coming from developing countries, particularly India, China, and Pakistan, though overall usage levels remain below those of high-income countries. Developing countries are, however, expected to close this gap. The growth of usage in developing countries is a concern for antibiotic resistance due to a higher potential for misuse – they are often available without prescription – and due to aggregating factors like poor sanitation, which can help resistant microbes to spread. At the same time, access to antibiotics remains a challenge in

many developing countries, with many people unable to take advantage of their benefits. Global antibiotic use is projected to increase by as much as 161% by 2030 (depending on usage rate assumptions), and greater resistance is likely to accompany that increase.

Trend Graphic:



Percent of Bacterial Infections in the US Showing Antibiotic Resistance, 2000-2015

Source:

Center for Disease Dynamics, Economics and Policy
https://resistancemap.cddep.org/AntibioticUse.php

Potential Downstream EIs in this Report: "Living Medicine"; "Kids Curing Kids"; "Runaway Microbial Tribbles"

Things to Consider

Will a more distributed healthcare system that empowers patients result in greater antibiotic use? Will the advent of living medicine (use of viral bacteriophages) rewrite the rules of microbial resistance?

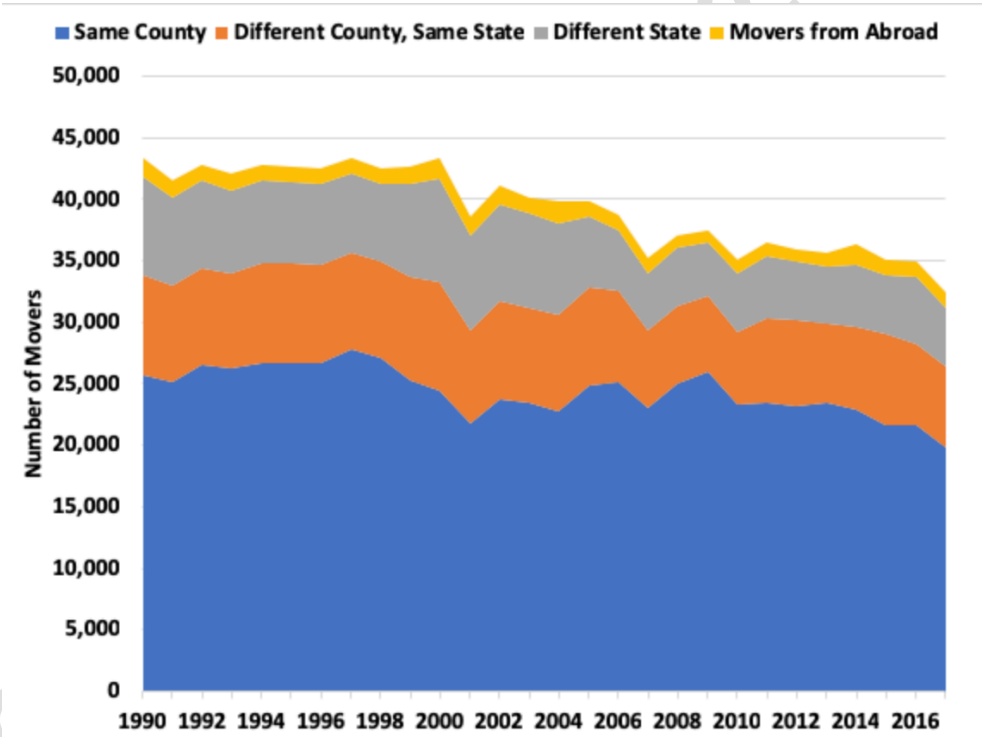
4. The U.S. is Becoming Less Geographically Mobile

Today the US population moves less frequently and over less distance than at any time since 1948. Barriers to mobility are making it harder for lower-income households to find better employment elsewhere, potentially worsening inequality.

Topic Area:	Demographic Shifts
Trend Drivers:	Population aging; growth of remote and gig work; rising costs of living; rising job stability
Nature of the Trend:	Slow, decreasing linear trend
Description:	The share of the U.S. population moving domestically each year reached a record low in 2016, with only around 11% of Americans relocating that year compared to an average of 18% during the 1980s, and a high of 20.2% back in 1948. The distance people moved has also decreased significantly over time. The rate of moving from one state to another has fallen by 51% compared to the 1948-1971 average, and the rate of moving between counties in the same state fell 31%. Employment statistics provide another window into this decline in geographic mobility. In 1986, 41% of job seekers relocated to find employment. By 2018, only 10% of job seekers were relocating. While the number of movers has declined, where people are moving has remained relatively consistent. People continue to move from rural areas to urban areas—though migration to suburban areas is now seeing a resurgence. People continue to leave the Northeast and Midwest for the West and South. The fastest growing states over the last decade are all in the West or South: Texas (12.1%), Utah (11.8%), Colorado (11.1%), Nevada (10.9%), Arizona (9.5%), South Carolina (+8.4%), and North Carolina (+7.3%). There are several potential drivers behind the decrease in geographic mobility. Changes in the workplace are among the biggest. Workers today are keeping their jobs longer, reducing the job turnover that usually drives relocation. The rise of remote work and gig work is also reducing the need for workers to relocate for their jobs. Barriers to finding work across state lines have also increased, as different states now have different licensing requirements for many occupations. Lower income households are

also less likely to relocate to find better opportunities than in the past (the number of low-income movers has been declining faster than higher income movers), perhaps due to rising costs of living around the country. Declining geographic mobility makes even more important the diffusion of healthcare services to more areas even as the trend is toward the opposite: increasing health deserts. And even though workers may be keeping their jobs longer, they are less likely to get healthcare coverage from them than in the past. Increasing population densities in urban centers (those unable to move to the suburbs) could also lead to greater mental stress and an increased potential for the spread of infectious diseases.

Trend Graphic:



Number of Movers by Destination, 1990 to 2016

Source:

US Census Bureau CPS Historical Migration/Geographic Mobility Tables. https://www.census.gov/data/tables/time-series/demo/geographic-mobility/historic.html

Potential Downstream EIs in this Report: "Automation Driving Macroeconomic Reform;" "Co-ops at the End of Capitalism"; "The New Job Market"; "It Takes a Village"; "Automated Transport Networks"

Things to Consider

How will new forms of housing and resource sharing impact future mobility? Will people be able to move more if housing isn't such a limitation? How will the spread of the gig economy impact mobility?

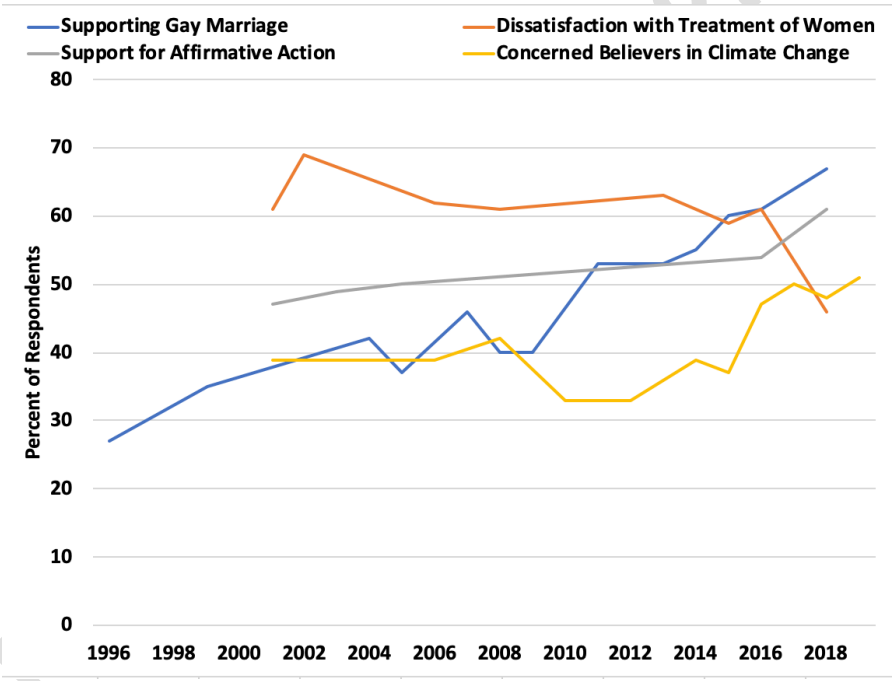
5. The U.S.'s Changing Cultural Values

Americans are increasingly dissatisfied with key aspects of U.S. *society, have become more liberal in their views of what is morally acceptable, and are more concerned about health and the environment.*

Topic Area:	Cultural Shifts
Trend Drivers:	Generational change; rise of the millennials; widening inequalities
Nature of the Trend:	Increasing trend, changes in beliefs appear to be happening faster than in the past
Description:	The U.S.'s culture is constantly changing as younger generations supplant old and as new immigrants come to this country. Over the last two decades, Americans have generally grown more dissatisfied with key aspects of U.S. society, have become more liberal in their views of what is morally acceptable and are more concerned about health and the environment. With regard to U.S. society, 65% of Americans in 2019 reported being satisfied with the 'opportunity for a person to get ahead by working hard', down 10 percentage points since 2001—even as a majority of them report being dissatisfied with the 'way income and wealth are distributed in the U.S.' (62%). 40% of Americans are satisfied with 'our system of government and how well it works,' down 28 percentage points since 2001 (the largest percentage point drop of any aspect). 37% were satisfied with the size and influence of major corporations, down 11 percentage points. And just 26% were satisfied with the moral and ethical climate in the country, down 10 percentage points. The public's views on gender and sexual identity, race, and other moral issues has become more liberal over time, with the percent satisfied with society's treatment of women having declined from 70% in 2001 to 53% in 2018. Public support for affirmative action programs for marginalized peoples has grown from 47% in 2001 to 61% in 2017 (among white Americans, support increased from 44 to 57% over the same time period). The percent of Americans in favor of gay marriage has grown from 27% in 1996 to 67% in 2018. Americans' views on climate change have also shifted – more now believe that a) climate change is occurring and that b) it is a serious threat. In 2019, for the first time, the majority of

Americans (51%) described themselves as "Concerned Believers," compared to 39% in 2001. Climate change skepticism has declined from a high of 28% in 2010 to 18% in 2016 (skepticism ticked up to 20% in 2019). Sixty-six percent of Americans now say that climate change is caused by human activities (up from an average of 60% between 2001-2014) and 45% think it will pose a serious threat in their lifetime (up from 35%). There remains significant 'belief-gaps', however, when age, sex, and partisan affiliation are considered. In 2019, 67% of 18 to 29-year-olds were "Concerned Believers" compared to 47% of those aged 65 and older. Along gender lines, 55% of women and 46% of men were CBs. Along partisan lines, 77% of Democrats and 16% of Republicans were CBs.

Trend Graphic:



Americans' Responses to Gallup Surveys, 1996-2019

Source:

Gallup, 2019. "Americans' Support for Affirmative Action Programs Rises.", Gallup, 2019. "Americans as Concerned as Ever About Global Warming.", Gallup, 2019. "Record-Low 46% of Women Pleased with Society's Treatment.", Gallup, 2018. "Two in Three Americans Support Same-Sex Marriage."
https://news.gallup.com/poll/234866/two-three americans-support-sex-marriage.aspx

Potential Downstream EIs in this Report: “Everywhere” Living Online; “Co-ops at the End of Capitalism”; “It Takes a Village”; “Marijuana Freedom”; “Mobilizing Menstrual Equity”

Things to Consider

To what degree will these value divides affect future social cohesion? Will the majority’s heightened concern over the health system and the environment eventually push the government to take strong actions (regardless of political party)?

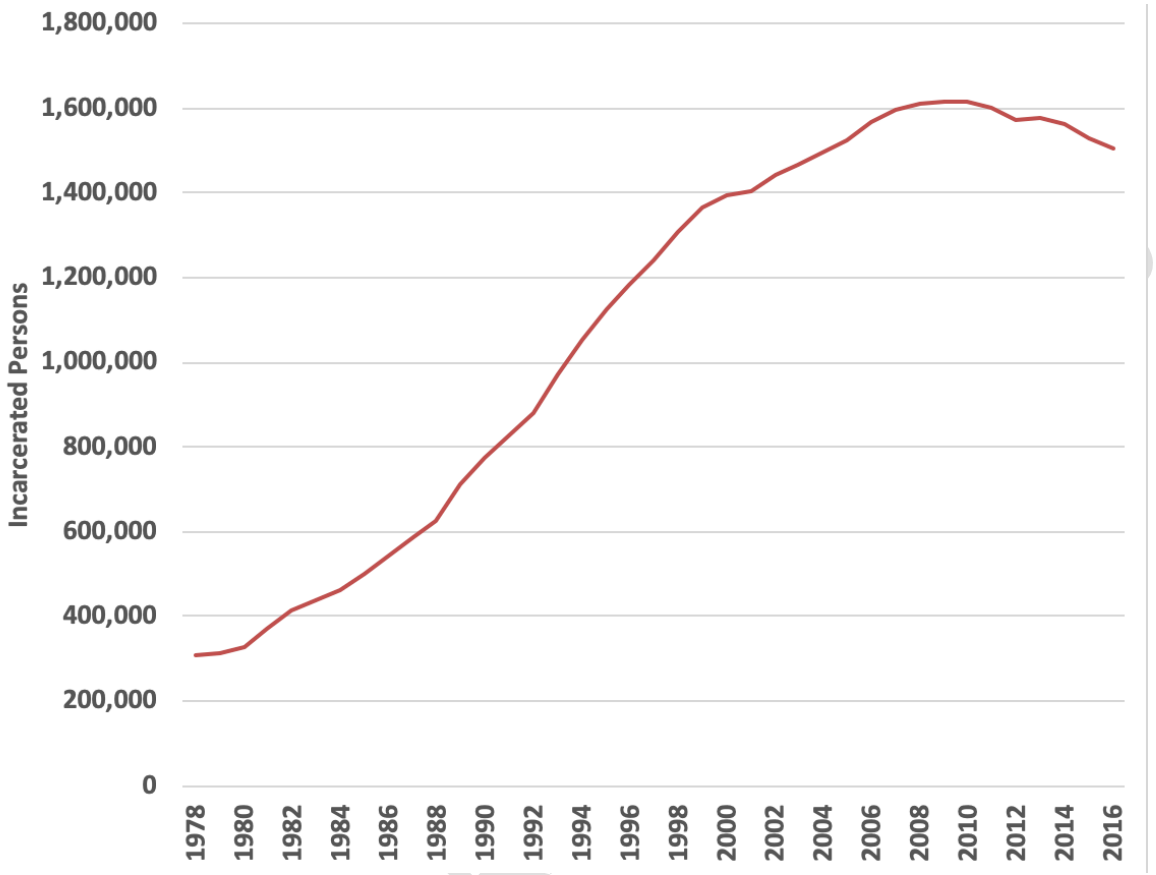
6. Incarceration Nation on the Decline

The decades-long rise in incarcerations in the U.S. *is beginning to reverse due to changing sentencing laws and a long-term decrease in crime rates, but the current decline is not equally distributed.*

Topic Area:	Equity
Trend Drivers:	Changes in sentencing patterns; changes in criminal laws for drug-related crimes; changes and transparency in unequal law enforcement practices, a long-term decrease in the crime rate; population aging; and potential economic growth after the Great Recession
Nature of the Trend:	Decreasing linear trend
Description:	The number of people incarcerated in the U.S. is beginning to decline after several decades of rapid growth. This recent reversal began around 2008 and has so far resulted in 126,000 fewer people being incarcerated nationally between 2008 and 2017. This slow, negative trend is being driven at least in part by changes in sentencing patterns, criminal law reform, and a general decrease in the crime rate. While national figures are improving, the picture remains mixed at the state level. Declines in California, New York and New Jersey account for most of the national decline while, in contrast, twenty states have seen incarceration levels increase, some to record highs. Much of the recent decline has also come from federal-level prisons (due to national-level reforms) while the number of people incarcerated at jails has remained largely flat. The incarceration rate is also declining and is now at its lowest level since 1996. The gap between white and black prison populations has also shrunk since 2008, though blacks and Hispanics are still disproportionately represented in the prison system due to many reasons, with racist policies and enforcement inequities being a strong driver. (For a definition of *racist* see Emerging Issue #39.) The U.S. continues to have the highest incarceration rate of any country in the world at 860 inmates for every 100,000 adults aged 18 and up. Should the current trend hold, the decline in incarceration rates among people of color could help close the income and wealth gaps as more people of color (particularly for

black and Hispanic males) are able to enter the workforce. Despite this, significant equity issues over incarceration rates and police treatment of people of color and indigenous people remains.

Trend Graphic:



Total U.S. Prison Population, 1978 to 2016

Source:

Bureau of Justice Statistics, US Department of Justice, Prison Policy Initiative, 2018
https://www.prisonpolicy.org/blog/2018/06/05/annualchanges/

Potential Downstream EIs in this Report: "Automation Driving Macroeconomic Reform"; "An American Authoritarian State"; "Demographic Assumptions Overturned"; "Marijuana Freedom"; "Turn Back to One Another, Rising Value of Care Work"

Things to Consider

Can the current trend be sustained? Accelerated? What policies, practices, and systems change are needed to continue the trend? As more people leave the prison system and as fewer people are sentenced to prison, alternative programs—particularly trauma healing and mental health support—may require additional funding.

7. Income and Wealth Gaps Continue to Widen

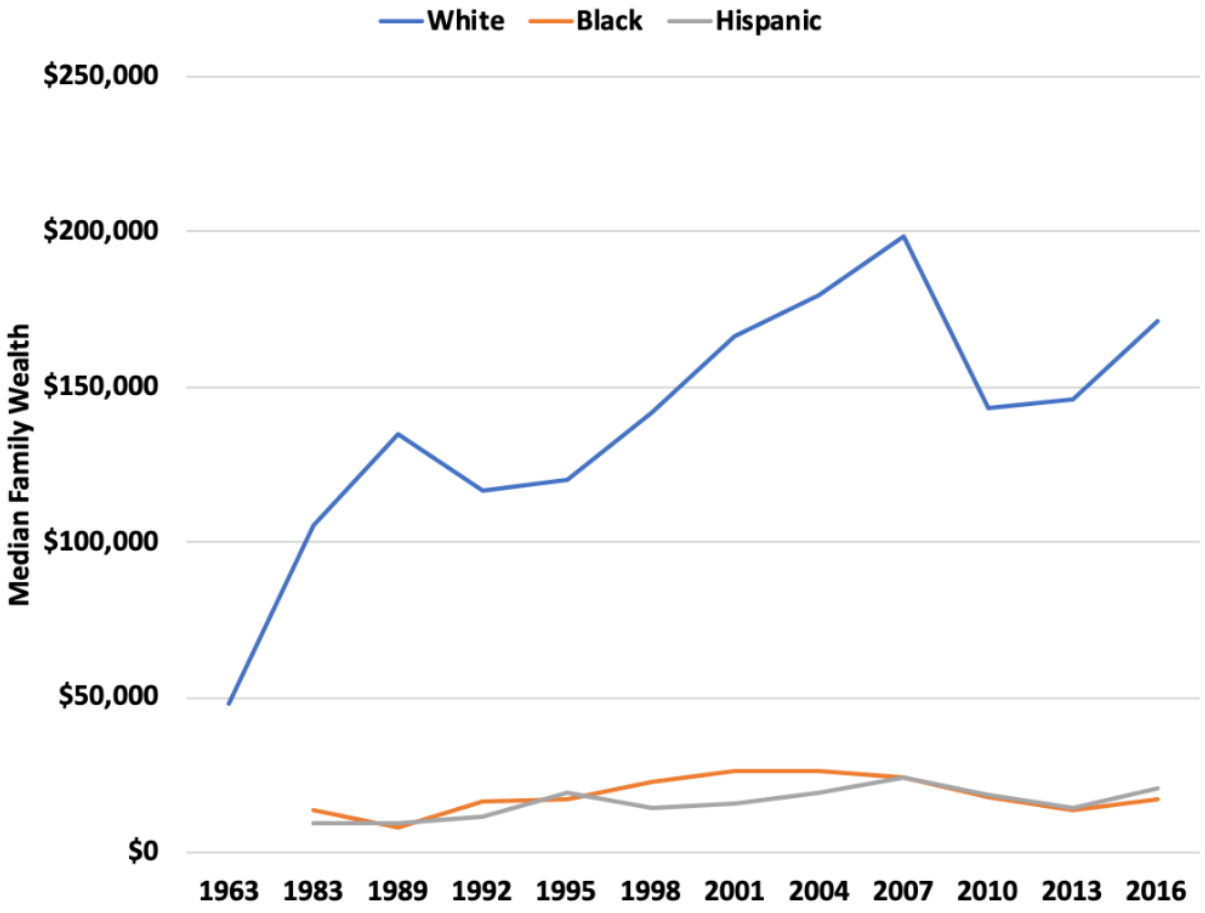
Income inequality and wealth inequality continue to worsen, particularly along race and ethnicity lines.

The wealth gap, even more than income inequality, poses a generational barrier to achieving greater equity as nonwhite families tend to have fewer assets with which to pass down wealth, limiting opportunities for their children.

Topic Area:	Equity
Trend Drivers:	Income inequality: educational inequalities, tax reforms that decreased progressiveness; decline of unions; wealth inequality: lack of homeownership by people of color; fewer retirement savings and more student loan debt held by people of color
Nature of the Trend:	Income inequality: Top 1% -- increasing linear trend; bottom 50% decreasing linear trend. Wealth inequality: top percentiles increasing linear trend
Description:	Income inequality has worsened significantly in the U.S., as measured in terms of the share of all income earned by the top 1% versus the share earned by the bottom 50%. Since 1980, the top 1% of income earners have seen their share double from 10% to 20-22% of all income earned, while the bottom 50% have seen their share decline from 20% to 13%. The last time income inequality was this great was just before the Great Depression, when the share of the top 1% was 24%. Gender-based income inequality has generally improved over time although it has widened at the highest earning levels. Over the same period, wealth inequality, as measured in terms of the value of a family's property and financial assets minus the value of their debts, has increased even faster than income inequality. Race and ethnicity are significant factors in wealth inequality, and this has worsened over time as institutional bias and racist policies continue to advantage whites over non-whites and this disadvantage carries on to new generations. In 1983, the median wealth of white families was 8 times greater than the median wealth of black families ($105,000 versus $13,000, respectively—in 2016 dollars). By 2016, the gap between white and black family wealth had grown to 10 times ($171,000 versus $17,000, respectively). While the median wealth of white family's grew by $66,000 between 1983 and 2016, median black family

wealth only grew by $4,000. Median Hispanic family wealth has increased slightly faster than black family wealth, but still remains 8 times less than white families.

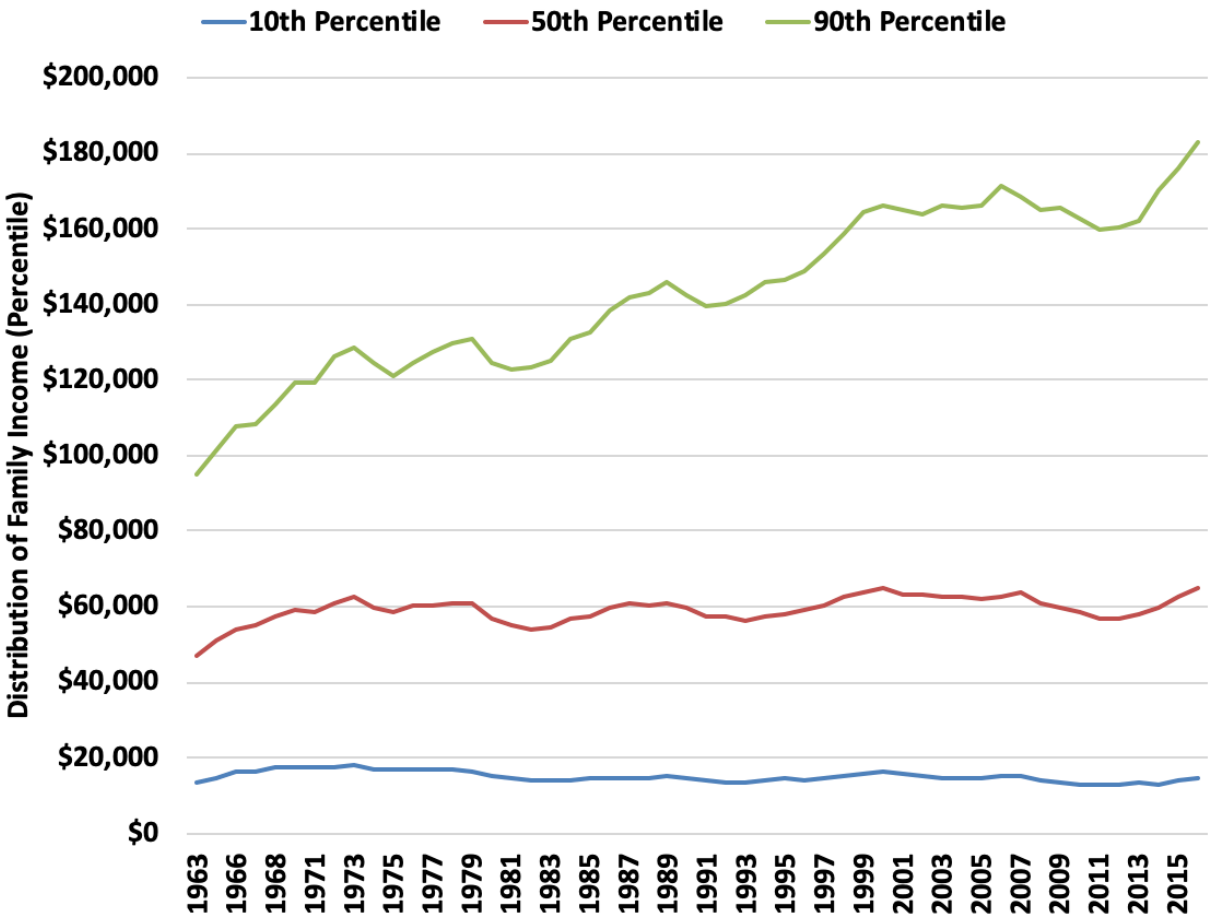
Trend Graphics:



Median Family Wealth by Race/Ethnicity, 1963-2016

Source:

Urban Institute, 2017 https://apps.urban.org/features/wealth-inequality-charts/



Distribution of Family Income, 1863-2016

Source:

Urban Institute, 2017 *https://apps.urban.org/features/wealth-inequality-charts/*

Potential Downstream EIs in this Report: "World Without Money"; "Turn Back to One Another, Rising Value of Care Work"; "Machine Charities"; "The New Job Market"; "Extreme Longevity for the Few"; "Co-ops at the End of Capitalism"

Things to Consider

Will the rise of the gig and sharing economies help close the income/wealth gaps by democratizing economic opportunity? Could new financial tools like Machine Charities and AI advisors help close the gap, getting funds to groups that have historically lacked access to support? Will these new economic models and financial aids remain accessible only by the few and simply not provide enough income to keep the gap from widening more?

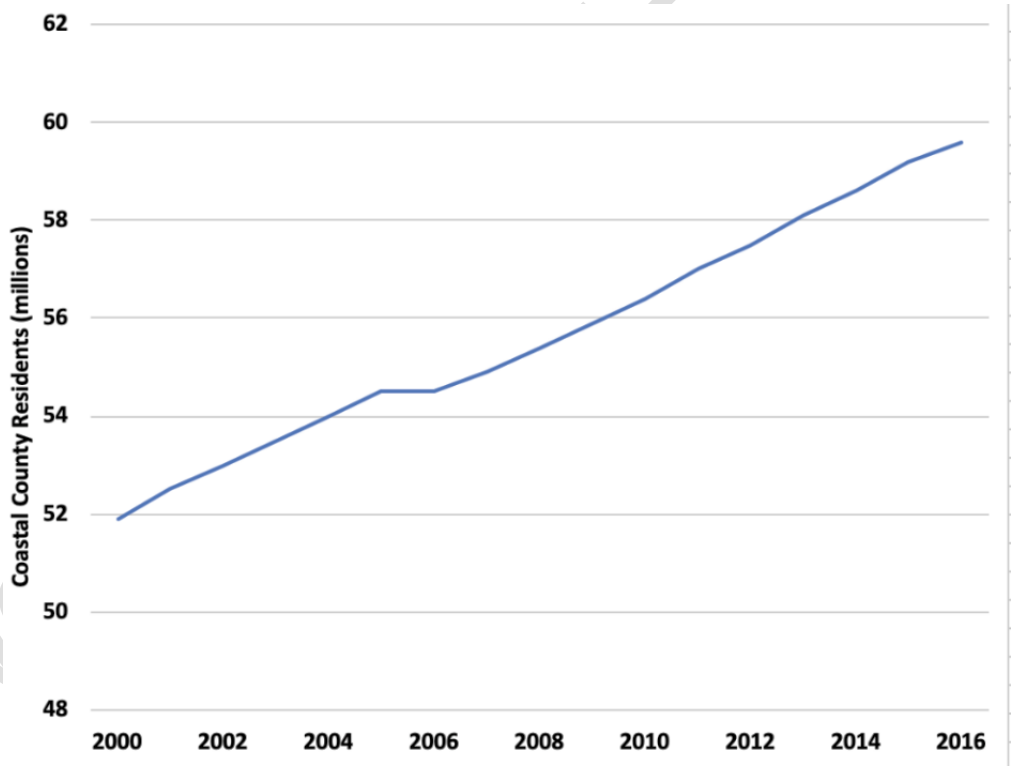
8. Increasingly Vulnerable but Still Growing Coastal Populations

Americans are continuing to move to coastline counties even as the threat from storms and sea level rise worsens.

Topic Area:	Climate Change
Trend Drivers:	Population movements; distribution of economic opportunities; urbanization; climate change
Nature of the Trend:	Increasing linear trend for population growth, increasing exponential trend for sea level rise
Description:	The U.S.'s coastline counties continue to see rapid population growth in the face of rising sea levels and more frequent storms. This combination is already resulting in more costly natural disasters and is likely to result in significant population displacement in the future as the impacts from climate change intensify. The country's littoral counties added some 34.8 million people between 1970 and 2010, reaching a high of 123 million people in 2010 (about 39% of the US total population). An additional 10 million people are projected to move to the coasts between 2010 and 2020 (about 5.3 million to the vulnerable Atlantic and Gulf of Mexico coasts). Many of the states currently experiencing the fastest growth are also some of the most vulnerable to coastal flooding and storms: South Carolina (+13.3%); Texas (+10.1%); Florida (+9.7%); Georgia (+7%); Delaware (+5.8%); and North Carolina (+5.7%). Sea level rise varies by geography. The US Gulf and Atlantic coasts are seeing seas rise faster than average, at about 1 inch per every 3 years, with the additional rise due to a combination of land subsidence and a slowing gulf stream. Forecasts for future sea level rise vary: by 2050, the U.S. coasts could see a sea level rise of 10 to 22 inches, and by 2100, of 2 to 6 feet. Recent projections suggest that 4.9 million Americans could be at risk of displacement under a 3-foot rise by 2100, while a 6-foot rise could displace as many as 13.1 million. Along with the considerable direct socioeconomic impact of hurricanes and flooding, the displacement of large numbers of people would have major long-term repercussions, especially for health (spread of disease, trauma) and well-being (housing, employment, loss of community, etc.).

Fastest Growing and Most Vulnerable Cities to Coastal Flooding			
City	Pop at Risk Today (100,000s)	Pop at Risk 2050 (100,000s)	% Change
New York	245	426	73.9%
Miami	126	154	22.2%
Fort Lauderdale, FL	85	127	49.4%
Hialeah, FL	76	204	168.4%
Charleston, SC	64	83	29.7%
Miami Gardens, FL	44	72	63.6%
Kendale Lakes, FL	37	51	37.8%

Trend Graphic:



Atlantic and Gulf Coast Coastline County Population, 2000—2016

Source:

Coastline County Population Data: US Census Bureau, https://www.census.gov/library/stories/2018/08/coastal-county-population-rises.html

Potential Downstream EIs in this Report: "Climate Crisis Impacts Health of Most Vulnerable"; "Climate Refugees and Adaptation"

Things to Consider

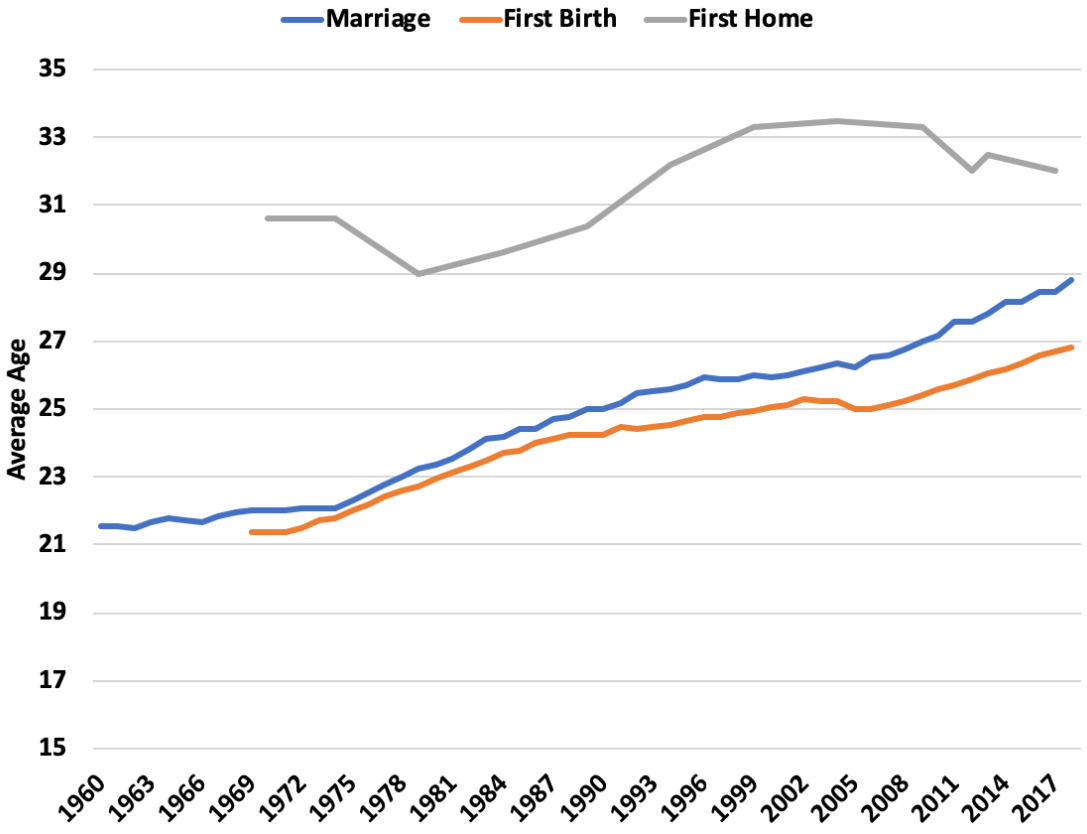
At what point will insurance companies simply no longer cover new construction along the coasts? Will those forced to relocate by sea level rise settle nearby or move to other parts of the country? – i.e. will local disruption remain local or go national? Will local "national" disasters become too costly for the federal government, exacerbating socio-economic divides?

9. Life Stages Shifting

Americans are entering major 'life stages' later in life, from getting married and starting a family, to entering and exiting the labor force. They are also increasingly less likely to follow a traditional path of timing and sequencing.

Topic Area:	Culture Shifts
Trend Drivers:	Cost of living; low-incomes and slow wage growth; advances in education and equality for women; changing values; ballooning student loan debt
Nature of the Trend:	Slow, increasing linear trend
Description:	Cultural and socioeconomic forces are leading more people to change the timing and sequence of major life events. Americans are now getting married later – the average age of first marriage has increased from 21 in 1960 to 29 in 2018. They are having children later – the average age for a woman having her first child has increased from 21 in 1970 to 27 in 2018. They are buying homes later – from 30 in 1970 to 32 in 2018. They are even retiring later – from 57 in 1990 to 62 in 2018 — reversing an earlier trend of decreasing age of retirement. Americans are also more likely to enter major life stages out of the traditional linear sequence—the percent of children born outside of marriage, for example, has increased from less than 10% in 1960 to 45% in 2017. Similarly, more people are now interrupting careers to return to school before starting a second or third career. Others are retiring only to reenter the workforce again. These long-term cultural shifts are having a number of impacts, including increasing demand for specialized health services for older mothers, health and social services for older workers, and education services for lifetime learning.

Trend Graphic:



Average age of different 'life stages' over time, 1960 to 2017

Source:

CDC National Center for Health Statistics, 2017, https://www.cdc.gov/nchs/nvss/births.htm

US Census, 2018. "Historical Marital Status Tables." https://www.census.gov/data/tables/time-series/demo/families/marital.html

Zillow, 2015. "Today's First-Time Homebuyers Older, More Often Single.", http://zillow.mediaroom.com/2015-08-17-Todays-First-Time-Homebuyers-Older-More-Often-Single

Potential Downstream EIs in this Report: "Turn Back to One Another, Rising Value of Care Work"; "It Takes a Village"; "Extreme Longevity for the Few"; "Elder Exploitation"; "Demographic Assumptions Overturned"

Things to Consider

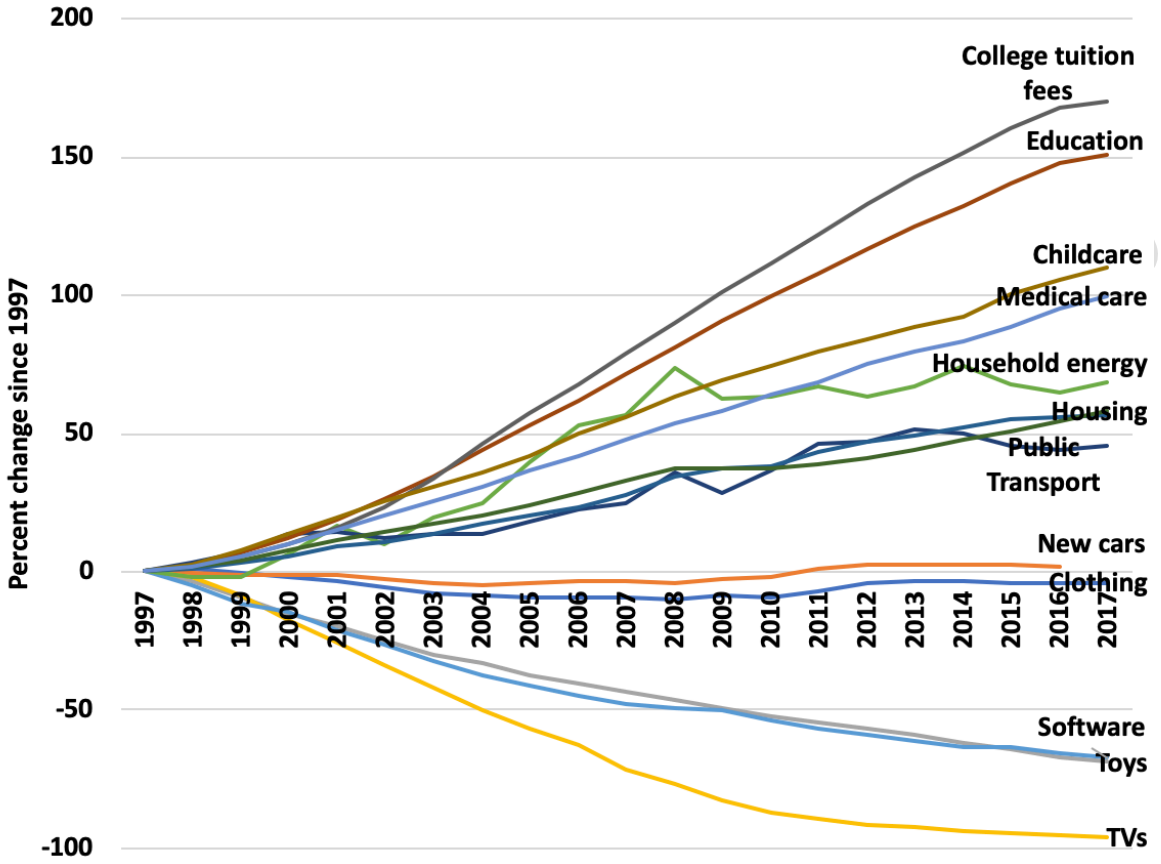
Are there any factors that might reverse this shift in life stage timing, or will the current trend continue? What impact would extreme longevity have on changing peoples' sequencing of life stages?

10. Rising Costs of Living are Gentrifying the Nation's Cities

The costs of essential services are rising rapidly in many high-population urban centers, widening the affordability gaps between cities and surrounding areas.

Topic Area:	Equity
Trend Drivers:	Overly concentrated economic growth; shortage of housing in key areas; little productivity growth in service sectors leading to increasing wages and higher prices; feedback loop of gentrification
Nature of the Trend:	Increasing, linear trend for most consumer goods, decreasing saturating trend for consumer electronics and toys
Description:	The cost of living is rising rapidly in U.S. major cities, creating a widening affordability gap between high-population urban centers and other communities. This gap is now growing faster than at any time in the last 20 years. In 2007, the country's twenty most expensive urban centers had an average cost of living (composite index measure) 50% greater than the average for the rest of the country. By 2018, the cost of living in these cities was 62% higher on average than surrounding areas. The income level required to 'live comfortably' in these twenty cities increased by an average of $13,000 between 2017 and 2018 alone. Housing remains a primary driver of this increase, but the rising cost of essential services like childcare, medical care, and education are also pushing the cost of living up. The current economic expansion is helping wages hold pace with inflation, but cost increases in essential services continue to exceed inflation. The increasing cost of services like childcare (110% increase since 1997), medical care (+99% since 1997), and education (+151%) can have a significant, detrimental impact on low and middle-income households in urban areas. Services may be cheaper in rural areas but tend to be less available—particularly medical care—and they tend to be of lower quality. Even when such households are not priced out of the services, they will have less money to devote to building the human capital and physical assets needed to move up the income ladder. Access to education and childcare are especially important to such households. Thus, as the cost of living increases, those households already relatively well-off will be the ones most able to move further up the ladder. The result is increased inequality and gentrification as current low and middle-income residents are priced out of housing and opportunities.

Trend Graphic:



Price changes in consumer goods and services for all Urban Consumers since 1997, 1997—2017

Source:

US Bureau of Labor Statistics. Consumer Price Index, https://www.bls.gov/cpi/

Potential Downstream EIs in this Report: "It Takes a Village"; "World Without Money"; Autonomous Transport Networks"; "The New Job Market"

Things to Consider

Will rising costs/gentrification result in a permanent enclave-ization of the U.S., where cities become 'large gated communities'—unaffordable to most, while the countryside is repopulated by those economically excluded from the cities?

11. Deepening Battle Over Vaccines

The number of unvaccinated children is increasing, weakening US herd immunity. This increase is due both to the antivaxx movement and the growing cost in time and money of keeping children vaccinated.*

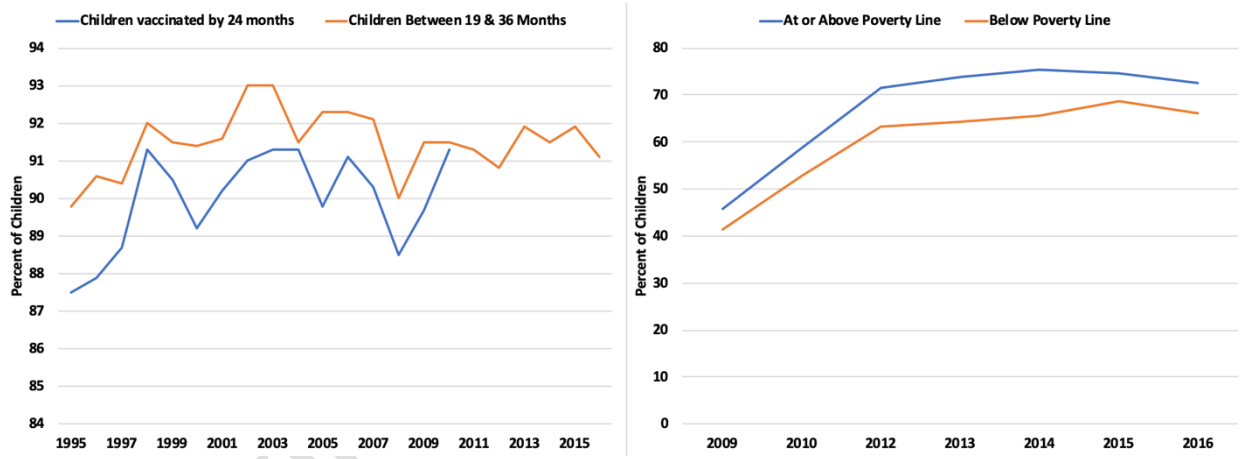
Topic Area:	Healthcare System
Trend Drivers:	Increasing distrust of health system, government and vaccines; increasing cost and time required to ensure children are vaccinated; lack of financial incentives for combination vaccines or other means of making vaccines easier for all to access
Nature of the Trend:	Slow increasing linear trend for unvaccinated children; slow, decelerating, increasing trend for vaccinated children
Description:	The percentage of unvaccinated children in the US has increased over time, from 0.3% in 2001 to 1.3% in 2015, while the percentage of parents refusing at least some vaccines for their children increased from 2.5% in 2010, to 4.2% in 2016. The antivaxx movement—and increasing distrust of institutions more generally—is at least partly responsible: a 2018 poll showed that support for vaccines (those who believe 'vaccines are crucial to public health') declined by 10% between 2008 and 2018. Other drivers include increasing costs and increasing time required to ensure a child is properly vaccinated. In 2017, 17.2% of unvaccinated children were also uninsured, compared to just 2% of all children. In 2016, only 60% of children living below the poverty line received the Rotavirus vaccine compared to 73% of the general population. Vaccination rates also vary significantly by state, with Colorado, Idaho, Kansas, Arkansas, and Pennsylvania having rates below 88% for kindergarteners in comparison to sixteen states with vaccination rates above 96% for kindergarteners. At the same time, there has been real progress. The percentage of children receiving the full seven-vaccine series recommended by the CDC has increased from 69% of children born in 2010 to 77% of children born in 2013, and the individual rates for the seven vaccines passed 80% in 2016 (though additional improvement is needed to achieve herd immunity for some diseases—diphtheria, pertussis and measles). A significant majority of Americans remain confident in vaccine safety (32% 'very confident,' and 53%

'somewhat confident') compared to those who questioned it (12% were 'not too confident' and 6% were 'not at all confident').

Views regarding the safety of vaccines vary by country. The U.S. has a relatively low level of mistrust (13.5% of respondents questioned vaccine safety)—on par with Canada and Mexico. In comparison, Japan, Russia, France, and Greece, all had response rates of 25% to 30% questioning vaccine safety. And some countries - Pakistan, the DRC - have seen violence break out over vaccine drives.

* "The resistance to the spread of a contagious disease within a population that results if a sufficiently high proportion of individuals are immune to the disease, especially through vaccination."
https://www.lexico.com/en/definition/herd_immunity

Trend Graphic:



Vaccination Rate by Age Group and Income, 1995 to 2015

Source:

CDC Health, United States 2017, Table 66,
https://www.cdc.gov/nchs/data/hus/2017/066.pdf

Potential Downstream EIs in this Report: "Living Medicine"; "Mainstream Health with Consequences"; "Kids Curing Kids"

Things to Consider

Violence against vaccination workers and vaccination drives is a growing issue in other countries—could it occur in the U.S. as vaccination rules grow stricter? How can vaccine makers and the government best convince the public of vaccine safety? Will new vaccines, like the HPV vaccine, be met with ever-increasing mistrust?

12. The U.S. is Becoming Increasingly Diverse

The U.S. is undergoing a demographic transition from a majority white population to a population without a single majority group—a transition that could either herald a more liberal and inclusive society or an even more polarized society with growing divides along ethnic/racial and generational lines.

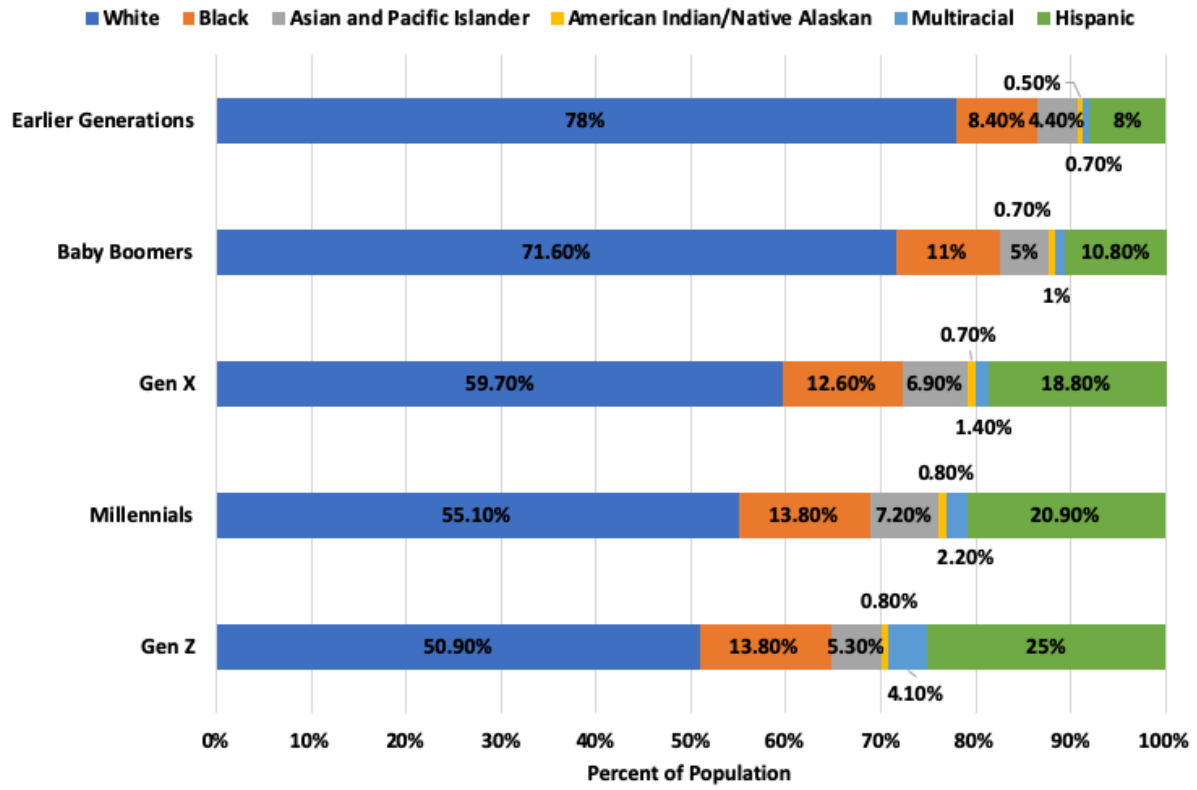
Topic Area:	Demographic Shifts
Trend Drivers:	Immigration, falling fertility rates, population aging, changing social mores
Nature of the Trend:	Increasing linear trend
Description:	The U.S. population has been majority white since the country's founding, but this is changing. Over the last half century, the U.S. population has shifted from 84% white and 16% people of color (11% Black, 4% Latino, and 1% Asian) in 1965, to 62% white and 38% people of color (12% Black, 18% Latino, and 6% Asian) today. Should current demographic trends continue, by 2044 the U.S. population will likely diversify to the extent that whites are forecast to make up 49.7% of the population, and people of color 50.3% (13.1% Black, 24.6% Latino, 7.9% Asian, and 3.8% Multiracial). This shift towards greater diversity is most clearly visible when considered on generational lines. Today's young generations are the most diverse in the country's history. Those under the age of 15 are already primarily people of color, 50.1%; only 49.9% are white. Generation Z (those born between 1995 and 2015) are 50.9% white, 13.8% Black, 5.3% Asian/Pacific Islander, 0.8% American Indian/ Native Alaskan, 4.1% multiracial, and 25% Latino. Contrast that with the Baby Boomer generation: 71% white, 11% Black, 5% Asian/Pacific Islander, 0.7% American Indian/Native Alaskan, 1% multiracial, and 10% Latino. At the state level, fourteen states plus DC now have minority white populations for the under-15 age group, including California Texas, Florida, and New York. Four main drivers are responsible for powering this trend toward increasing diversity among the younger generations: 1) increasing immigration levels from outside Europe; 2) declining fertility rates; 3) population aging; and 4) changing social mores regarding interracial marriage and gender equity. While the number of all

immigrants entering the U.S. has grown over time, fewer immigrants now are coming from European countries than in the past, while more are coming from the rest of the world. Fertility rates are now declining for all ethnic/racial groups, but white women are seeing a much more rapid decline than other groups due generally to their having both greater household wealth and better access to education and health services. Declining fertility rates also drive up the median age of the population. The median age of the white population in the U.S. is rising faster than other groups—the white median age in 2018 was 43.6 compared to 29.5 for Latinos and 20 for multiracial populations.

The Baby Boom was primarily a white phenomenon, and so has fewer women of childbearing age than in the past. Between 2000 and 2018, 92% of the country's population growth came from people of color, half from Latinos. Changing social mores regarding interracial marriage are also driving an increase in multiracial children, who are now the fastest growing population subgroup, followed by Asians/Pacific Islanders and Latinos. That group is projected to more than double by 2060 to around 12% of the population.

The country's changing demographics are, unfortunately, providing a narrative for the far right in the U.S.'s increasingly partisan civic and political landscape, with 46% of Americans and 59% of Republicans reporting having fears that a "majority minority" population might weaken "American culture" and prompt more ethnic and racial conflict, while 30% of Americans and 42% of Democrats report feeling that this would actually help strength U.S. customs and values.

Trend Graphic:



US Race-Ethnic Profiles of Major Generations by percent of population, 2018

Source:

Brookings, 2019. "Less Than Half of US Children Under 15 are White, Census Shows." https://www.brookings.edu/research/less-than-half-of-us-children-under-15-are-white-census-shows/

Potential Downstream EIs in this Report: "Turn Back to One Another, Rising Value of Care Work"; "Personalized Medicine"; "Mobilizing the Menstrual Equity"; "Demographic Assumptions Overturned"

Things to Consider

Will the strong divide in diversity between old and younger generations result in more tension between the generations? Will the shifting racial/ethnic makeup of the U.S. *prompt a redefinition of racial categories?*

13. The U.S.'s Shifting Faith Landscape: increasing secularization and increasing diversity

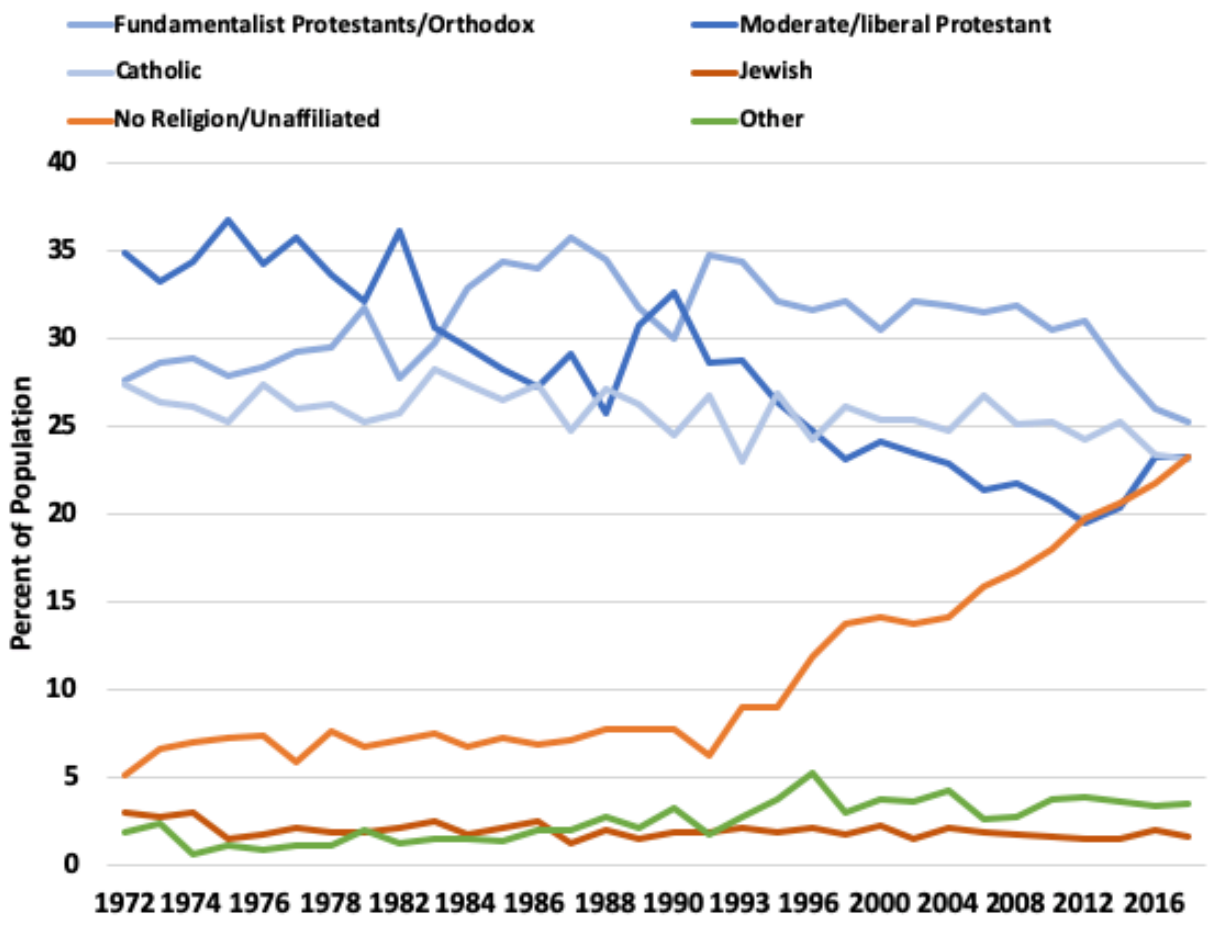
The U.S.'s faith landscape is undergoing a significant generational shift from historically dominant traditional Christian denominations toward greater secularism and religious diversity.

Topic Area:	Culture Shifts
Trend Drivers:	Population aging, immigration, increasing levels of education, greater acceptance of secularism, church scandals, the internet providing a means for secularists to connect/organize
Nature of the Trend:	Increasing linear trend for unaffiliated group; declining linear trend for Christian groups
Description:	The U.S.'s faith landscape today is undergoing three simultaneous seismic shifts toward: 1) greater religious diversity; 2) greater ethnic / racial diversity within Christianity; and 3) greater secularism. Christianity, particularly Protestantism, remains the dominant religion in the U.S., but the share of Americans identifying as Christian has declined over time. In 1948, 70% of Americans identified as Protestant. Today, that percentage stands at 35%. Catholicism's share is also on the decline. After experiencing a period of growth from 1948 to the 1980s (reaching a high of 29% in 1982), the share of Catholics in the US population has declined to 22% today. Other religions—Islam, Buddhism, Hinduism, Judaism—continue to grow, rising from1-2% in 1948 to 7.5% today, but their rates of growth are now slowing. The fastest growing religious group today are those identifying as unaffiliated / no religion / secular. In 1948, 1% of the U.S. population identified as having no religion. In 2018, that percentage had reached 23%, with much of that growth coming after 2000. The demographics of religion are also changing. Christians in the U.S. are increasingly nonwhite. In 1976, 81% of Americans identified as white and Christian, today, they only represent 43%. The white population has also become significantly more likely to be unaffiliated or to affirm no religion compared to other populations, though the unaffiliated share among people of color is also rising. There appear to be a confluence of demographic and socioeconomic drivers behind these trends. Immigration patterns

are shifting from European immigration to immigration from Asia, Africa and Latin. In the U.S., younger generations are more diverse, better educated, and more tolerant of religious diversity and secularism.

The increase in religious diversity and the growth of unaffiliated / no religion groups also have a geographic component. In general, states in the West, Great Lakes, and New England regions tend to be the most religiously diverse while those in the Midwest and South tend to be significantly less diverse. In twenty states, mostly in the West, the unaffiliated / no religion group now makes up the largest population share of any religious group.

Trend Graphic:



GSS Survey of Religious Preference, 1972-2018

Source:

GSS Data Explorer, https://gssdataexplorer.norc.org/trends/Religion%20&%20Spirituality?measure=relig_rec

Note: Other category includes Buddhism, Hinduism, Other Eastern, Moslem/Islam, Native American, and inter-nondenominational.

Potential Downstream EIs in this Report: "An American Authoritarian State"; "Demographic Assumptions Overturned"; "Increasingly Extreme US Political Swings"

Things to Consider

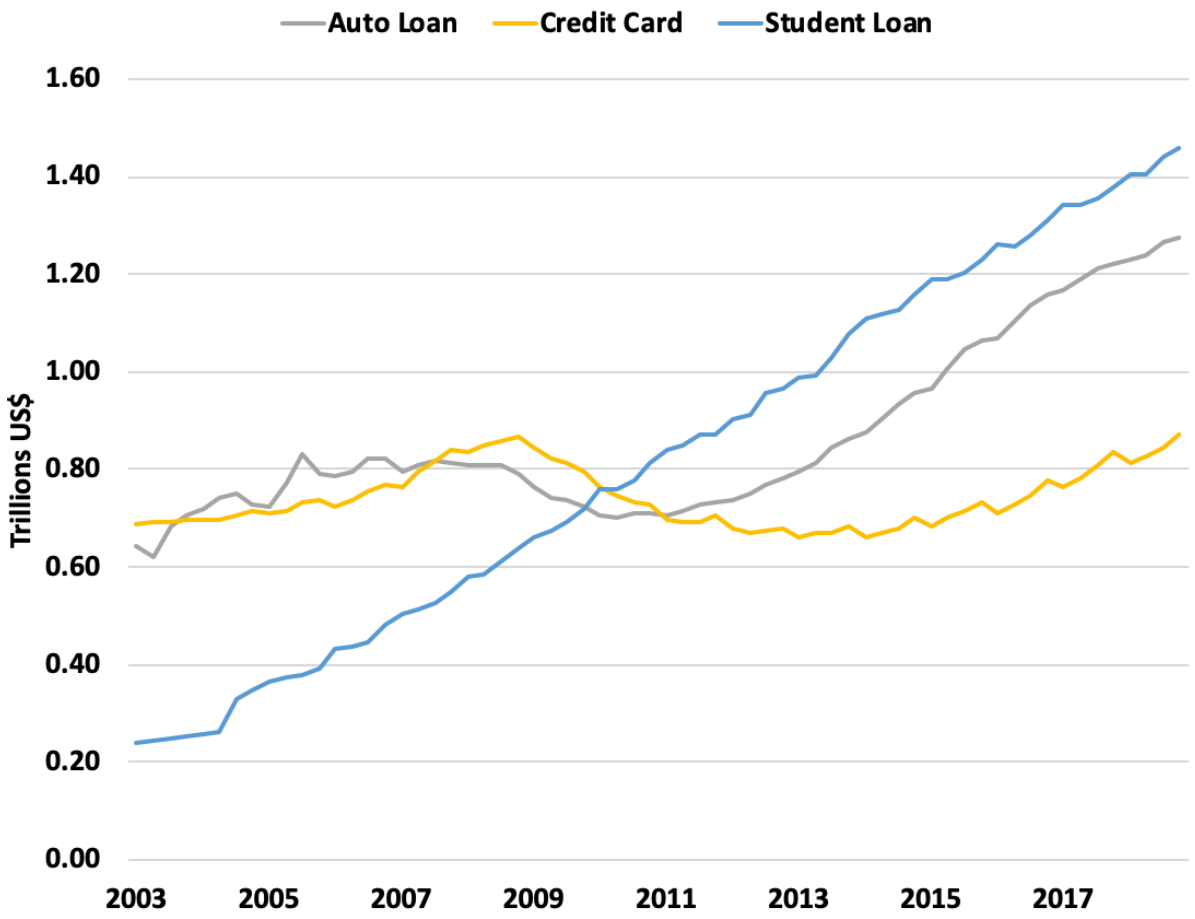
Will the continued decline in Christianity and organized religion more generally prompt a stronger backlash by religious groups? Will today's youth truly remain unaffiliated/secular or will they return to organized religion as they grow older?

14. Ballooning Student Debt

The increasing burden of student loans means many borrowers must delay many important life decisions and is worsening inequality.

Topic Area:	Social Contract
Trend Drivers:	Cost of education; wages not keeping up with cost of living; high paying jobs requiring mode advanced/multiple degrees; poor debt management
Nature of the Trend:	Increasing, rapid linear trend
Description:	Student loans are now the fastest growing form of household debt and the second largest source of debt outside of mortgages. The total amount of student debt reached a record $1.56 trillion in 2019 (roughly $4920 for every person in the US). Some 44.7 million Americans, or 1 in 5 adults, currently hold student debt, with the average amount owed at a record high of $32,000 (when combining student and parent borrowers). This rising debt burden is having a significant socioeconomic impact on society, with borrowers having to wait longer to start a family, buy a house, and even become an entrepreneur. It is also affecting choices significantly later in life as the fastest growing age group of borrowers are now adults aged 60 and older—the numbers of whom have more than doubled over the last ten years (the majority of borrowers are still under the age of 30) but the average age is shifting older. The ballooning of student loan debt also worsens inequality in the country, as those who leave school with debt but no degree find it increasingly difficult to pay back such loans. Even students who complete their degrees often face monthly payments of $200 to $300 per month, which can be a significant burden. Student debt also represents a stream of dollars not added to local economies. 11.4 percent of student loan holders (5.1 million people) are currently in default, unable to keep up their payments. The increasing cost of education is certainly a primary driver, but there are other causes, including the fact that many borrowers never get into the right repayment plan and are faced with unreasonable payments.

Trend Graphic:



Personal Debt by Type, 2003-2017

Source:

Federal Reserve Bank of New York. Quarterly Report on Household Debt and Credit.

Potential Downstream EIs in this Report: "World Without Money"; "Machine Charities"; "Co-Ops at the End of Capitalism"

Things to Consider

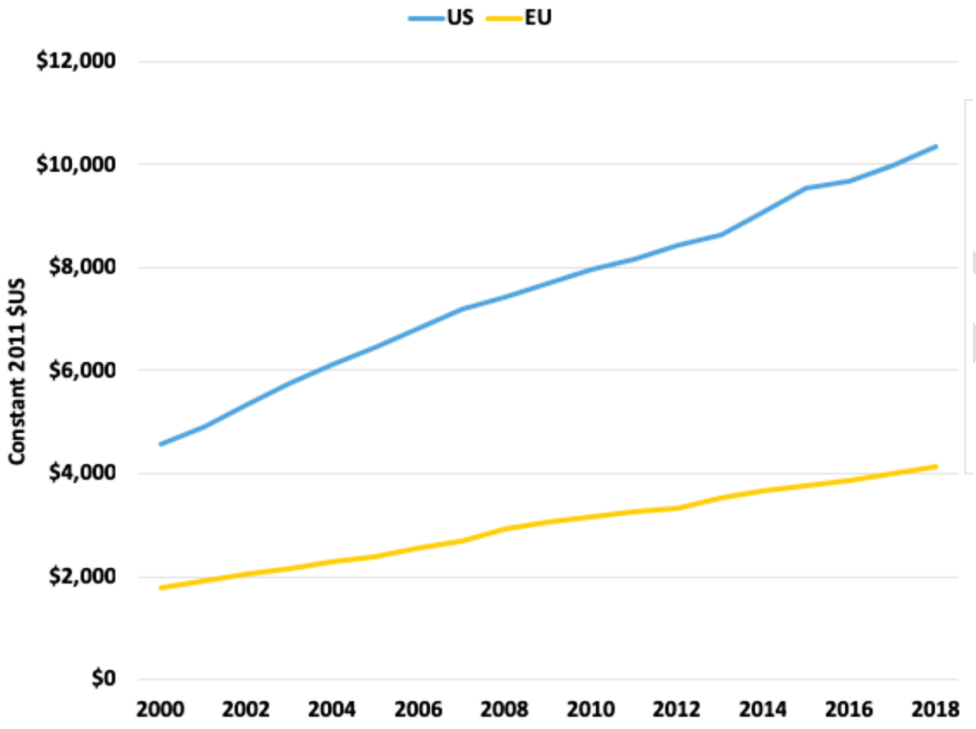
How much more student loan debt can the economy sustain? What happens if default rates increase significantly? What impact would student loan forgiveness have on the economy?

15. Runaway Healthcare Spending

Healthcare spending is rising worldwide, but the US spends per capita almost double what other high-income countries spend to achieve health outcomes that lag those same countries.

Topic Area:	Healthcare System
Trend Drivers:	Population aging; inefficiencies in the healthcare system; the opioid epidemic
Nature of the Trend:	Rapid increasing linear trend
Description:	The U.S. currently spends around $10,300 dollars per person on healthcare each year (total public and private spending), an increase of 226% since 2000. The U.S. spends 28% more than the next highest per capita spending country in the world, Switzerland, which spent $8,009 in 2017; the U.S. spends roughly twice what the EU does as a whole, per capita. U.S. healthcare spending has also grown at a faster rate than in other country, outpacing the average rate of growth for high-income countries since 1980. That rate of increase has, however, slowed in recent years and since 2010 is in line with the average of 3.7% growth per year. The U.S. has seen improvement in many health and wellness indicators since 1990, including reduced overall mortality, reduced preventable hospitalizations, and improved healthcare coverage. Nonetheless, it continues to lag behind many high-income countries despite higher U.S. spending. In 1990, the U.S. scored 80.7 out of 100 on the Healthcare Access and Quality Index (HAQ) produced by the Global Burden of Disease Study. By 2016, the U.S. score had risen to 88.7, an 8-point improvement, but still ranking only 28th on the Index. Australia, by comparison, saw an improvement of 12 points over the same period, from 83.9 to 95.9. The infant mortality rate in the US fell from 9.4 deaths per 100,000 live births in 1990 to an all-time low of 5.7. In comparison, over the same period the EU saw infant mortality decline from 9.8 to 3.4. The U.S. has also seen some health indicators worsen in recent years in contrast to other high-income countries, including maternal mortality and lifespan (due in significant part to the opioid epidemic).

Trend Graphic:



Total spending on healthcare per capita, 2000 to 2018

Source:

World Bank World Development Indicators. Data series on per capita healthcare spending.
https://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#

Potential Downstream EIs in this Report: "Diets as Medicine and Social/Ecological Justice"; "Extreme Longevity for The Few"; "Machine Charities"; "Living Medicine"; "Personalized Medicine"; "Turn Back to One Another, Rising Value of Care Work"

Things to Consider

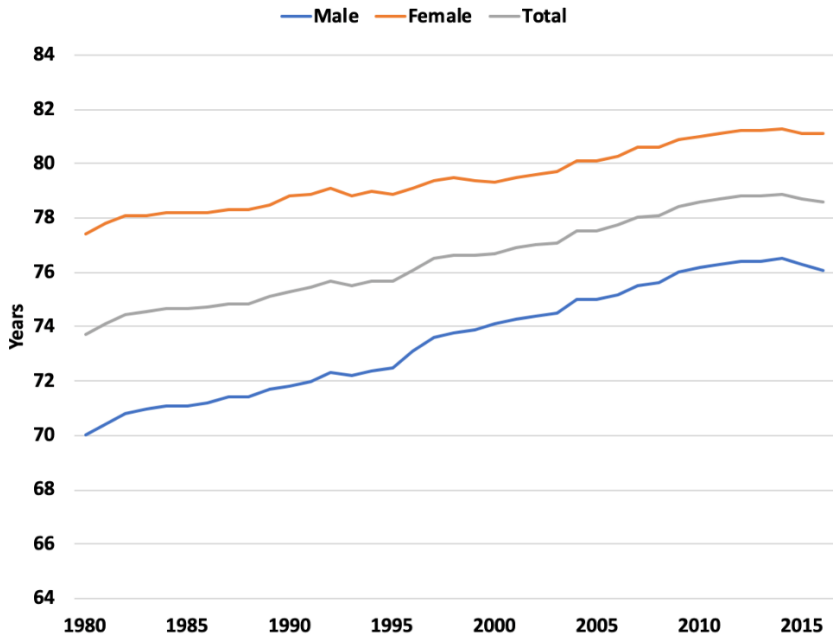
Will the health costs associated with an aging population and the rising prevalence of lifestyle diseases break the bank or will new technologies provide cheaper, more effective treatments?

16. Falling Life Expectancy

Rising rates of drug overdoses and suicides are causing U.S. *life expectancy to fall for the first time since WWI.*

Topic Area:	Healthcare System
Trend Drivers:	Opioid crisis; mental health crisis; lack of access to health services and resources; lack of access economic and social opportunities
Nature of the Trend:	Slow, declining trend after about 2014
Description:	Life expectancy in the U.S. has declined for three straight years after decades of nearly continuous increase—the last sustained decrease was due to the 1918 Spanish Flu pandemic. In 2014, U.S. life expectancy stood at 78.8, but by 2017 it had fallen to 78.6. The recent downturn in life expectancy is largely due to the increasing rate of drug overdoses (up 350% since 1999, with 70,000 deaths in 2017), suicides (up 33% since 1999, with 47,000 deaths in 2017), and chronic liver disease (up 31% since 2000, with 40,000 deaths in 2017). These three sources of mortality are not distributed equally. All three tend to disproportionally impact men (especially middle-aged, white men—and Native American men for liver disease), all three tend to be clustered geographically, with some states seeing significantly higher rates than others (West Virginia, New Mexico, and Montana especially), and all three tend to be higher in rural areas than in urban areas—all of which underlines the strong socioeconomic factors influencing these increases.

Trend Graphic:



Life Expectancy in U.S. by Sex, 1980-2016

Source:

Peterson-Kaiser Health System Tracker. 2019. "How Does US Life Expectancy Compare to Other Countries? https://www.healthsystemtracker.org/chart-collection/u-s-life-expectancy-compare-countries/#item-start

Potential Downstream EIs in this report: "Demographic Assumptions Overturned"; "Extreme Longevity for the Few"; "Mainstream Health Foods with Consequences"

Things to Consider

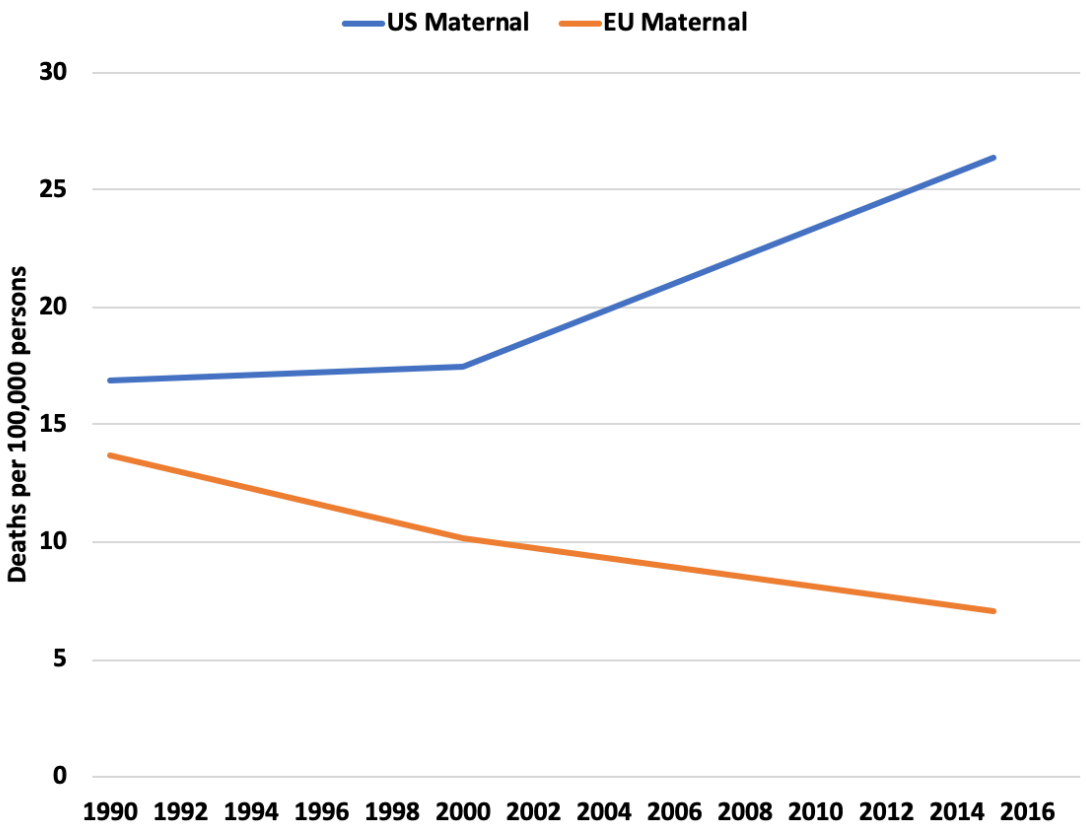
How can the U.S. *help reverse this trend? What is its root cause and what are effective responses? What happens when the wealthy can afford life extension treatments while the less well-off continue to see declines in longevity?*

17. Worsening Maternal Mortality in the U.S.

The increasing prevalence of chronic disease and unequal access to health services are combining to increase U.S. *maternal mortality rates—some states have rates equivalent to developing countries.*

Topic Area:	Healthcare System
Trend Drivers:	Increasing prevalence of chronic diseases; racial/ethnic inequalities in treatment and access to health resources; lack of social support; lack of standardized protocols in healthcare; increasing maternal age
Nature of the Trend:	Increasing, linear trend
Description:	The U.S. has the highest rate of maternal mortality of any developed country, at 26 deaths per 100,000 live births. This is on a par with China and Russia. It is the only developed country where the rate is increasing over time. American women are now 50% more likely to die of pregnancy-related complications than mothers a generation ago, with black women 3 to 4 times more likely to die from pregnancy-related complications than white women. Maternal mortality rates also differ significantly by state. Louisiana and Georgia have the highest rates in the country at 58 and 48 deaths per 100,000 births respectively – on par with Iraq. In contrast, California and Massachusetts have the lowest, at 4 and 8 respectively – on par with the top ranked countries in the world, like Sweden. It is estimated that roughly 60% of maternal deaths are preventable with today's medical technologies and practices. Health professionals are now working to enhance data collection and data-driven decision making, and to establish a set of standard protocols for dealing with pregnancy emergencies. But the drivers of this trend, particularly the incidence of chronic disease and lack of access to health services, suggest maternal mortality is likely to get worse before it gets better.

Trend Graphic:



Number of maternal deaths associated with pregnancy per 100,000 live births, 1990 to 2016

Source:

Global Burden of Disease Study, 2016. "Global, regional, and national levels of maternal mortality, 1990—2015: a systematic analysis for the Global Burden of Disease Study."

https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(16)31470-2.pdf

Potential Downstream EIs in this report: "Turn Back to One Another: Rising Value of Care Work"; "Personalized Medicine"; "Mobilizing Menstrual Equity"

Things to Consider

A confluence of trends is behind the rise of maternal mortality, meaning that reducing such mortality will require a multi-pronged approach. It is an open question which approaches will prove most effective.

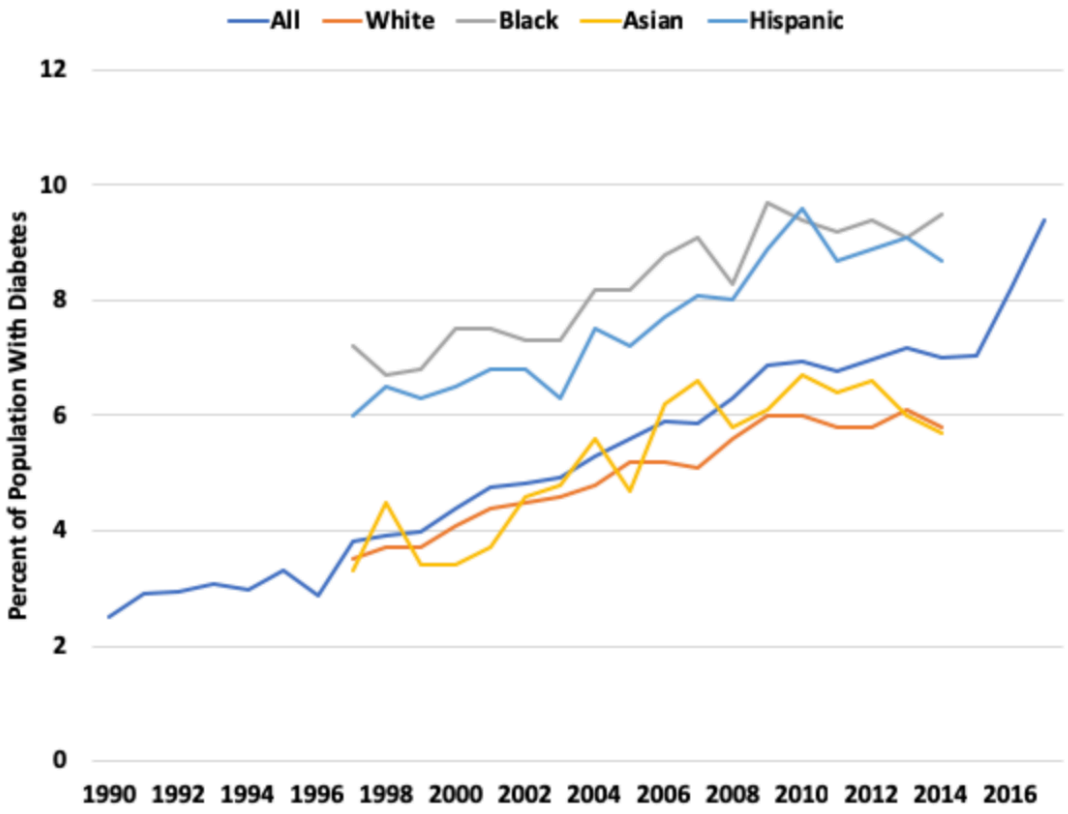
18. Unequal Burden of Disease

Certain socioeconomic and racial/ethnic groups are disproportionately impacted by the increasing burden of disease.

Topic Area:	Healthcare System
Trend Drivers:	Life challenges that result in rise of health care and food deserts; socioeconomic and racial inequalities; geographic disparities, and opioid access and use are factors that contribute to an unequal burden of disease.
Nature of the Trend:	Increasing, exponential trend
Description:	The U.S. is in the late stages of a long-term transition from the leading cause of death and morbidity being *communicable diseases*—caused by circumstances and factors over which people had little control – to *noncommunicable diseases*, which can be mitigated and altered through personal practices such as diet, substance abuse, exercise. This shift has been part of an overall reduction in mortality rates among the nation's general population (from 744 deaths per 100,000 persons in 1990 to 578 per 100,000 in 2016) as health care has improved. But this progress is not occurring for all racial/ethnic and socioeconomic groups because they lack access to conditions that can mitigate disease. Diabetes is one example reflecting both an increasing and an unequal impact. Over thirty million Americans (9.4% of the total population) now have diabetes (23.8% of whom are undiagnosed), up from 2.5% in 1990. An estimated 1.5 million people are diagnosed with diabetes each year and diabetes is now the seventh leading cause of death in the US. While diabetes prevalence is increasing across the country, rates are significantly higher in Southern and Appalachian states (West Virginia [15.2%], Mississippi [14.2%], Alabama [14.1%], Louisiana [13.6], South Carolina [13.4%]), and significantly lower in the West and Northwest (Utah [7.1%, Colorado [7.4%], Alaska [7.4%], Minnesota [7.8%]). The widest gap is between West Virginia, which has a diabetes prevalence comparable to Fiji and Tonga, and Utah, which is at about the same level as Thailand. The UK, by comparison, has a national rate of only 4.3%.

Diabetes prevalence is also highly skewed when it comes to race/ethnicity and age. In 2015, 7.4% of non-Hispanic whites had diabetes compared to 15.1% of American Indians and Alaska Natives, 12.7% for non-Hispanic blacks, and 12.1% for Hispanics. Diabetes is also increasing faster among non-white populations than the non-Hispanic white population. In terms of age, diabetes is most highly prevalent in adults aged 65+, but 10 to 19-year-olds are now the fastest growing age group for type-2 Diabetes—increasing at 5.2% per year—particularly non-white youth.

Trend Graphic:



Percent of Population with Diabetes, By Ethnicity and Total Population

Source:

CDC's Division of Diabetes Translation,
https://www.cdc.gov/diabetes/statistics/slides/long_term_trends.pdf

Potential Downstream EIs in this Report: "Demographic Assumptions Overturned"; "Diet as Medicine and Social/Ecological Justice"; "Sugar is the New Tobacco"

Things to Consider

How much more will diseases, like diabetes undercut historical health gains? How can people impact the factors underlying such diseases and improve access to conditions necessary to mitigate such disease?

19. Growing Rates of Anxiety, Depression, and Suicide

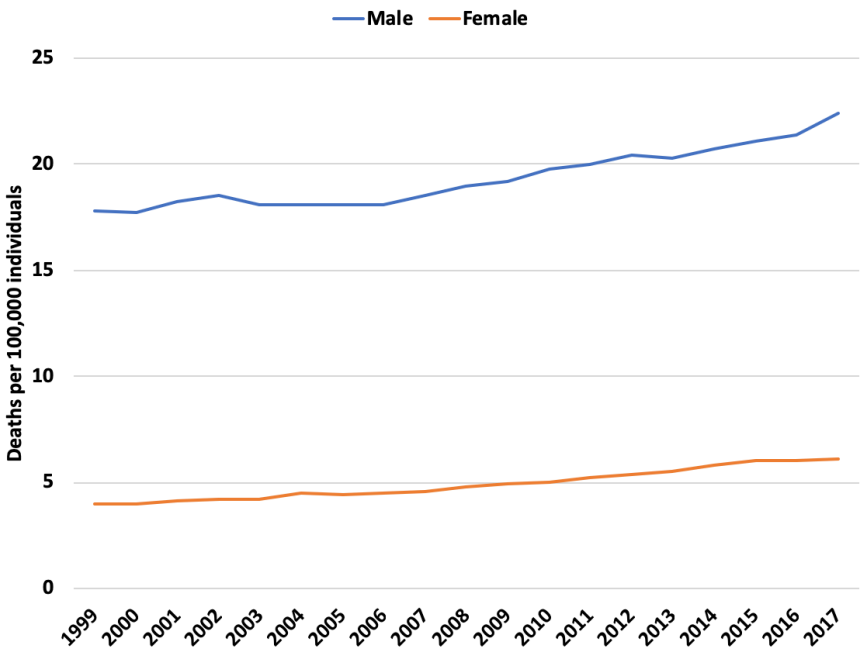
Anxiety, depression, and suicide rates are increasing across the U.S

Topic Area:	Healthcare System, Equity
Trend Drivers:	Urban/rural divide; lack of access to mental healthcare; affordability of mental health care; opioid epidemic; economic insecurity; social media
Nature of the Trend:	Increasing linear trend
Description:	The U.S. has seen a marked increase in anxiety, depression, and suicide rates over the past two decades. The U.S. is the third most anxious and depressed country in the world (after China and India) and is 27th with regard to suicide (at a rate of 15.9 per 100,000 in 2019). In contrast, Canada is 44th. Anxiety disorders affect roughly 18% of the U.S. population each year with about 3% suffering from generalized anxiety disorder. A 2018 poll regarding the general sense of anxiety found that 39% of Americans feel more anxious now than they did a year ago – in 2017, only 19% reported feeling more anxious. Millennials appear to be the most anxious generation overall, but anxiety levels are increasing faster for Baby Boomers. Depression in the U.S. has increased 33% since 2013, with rates increasing across all age groups and for both men and women, but particularly among young adults (young girls especially) where diagnosis rates are up 63%. Depression tends to be more common among women, with 10% of women aged 20+ identifying as depressed compared to 6% of men. Suicide is the tenth leading cause of death in the US at 15 suicide deaths per 100,000 in 2018 (up from 11.6 in 2008). The overall suicide rate is now at a 50-year high—up 25% since 1999 – but the rate increase is not even across the board. Over the last twenty years, much of the increase in the suicide rate has been driven by an increase in suicides among middle aged white men—particularly in rural areas—and among young adults, especially teenage girls. Suicide is now the second leading cause of death for ages 10 to 35 and the fourth leading cause of death for ages 35 to 54. Suicide in the U.S. is still a heavily male phenomenon, with 3.5 times as many

men dying by suicide than women; the male suicide rate has been increasing faster than the female rate.

Suicide rates vary significantly by ethnicity. Rates are highest for whites (at 15.85 deaths per 100,000) and much lower for Blacks and Asian Americans (6.61 per 100,000). The gap in suicide rates between urban and rural areas is also significant and widening. Between 1999 and 2017, suicide rates in rural areas grew from 13.1 people per 100,000 individuals to 20 per 100,000, while rates in urban areas increased from 9.6 to 11.1. Suicide rates increased in all states between 1999 and 2016 except Nevada. Idaho, Utah, North Dakota, South Dakota, Kansas, Minnesota, New Hampshire and Delaware all saw increases of more than 40% over the same time period.

Trend Graphic:



Suicide rate for males and females, 1999 to 2017

Source:

CDC, 2018. "Suicide Mortality in the United States, 1999-2017.", https://www.cdc.gov/nchs/products/databriefs/db330.htm

Potential Downstream EIs in this Report: "It Takes a Village"; "Turn Back to One Another: Rising Value of Care Work"; "'Everywhere' Living Online"

Things to Consider

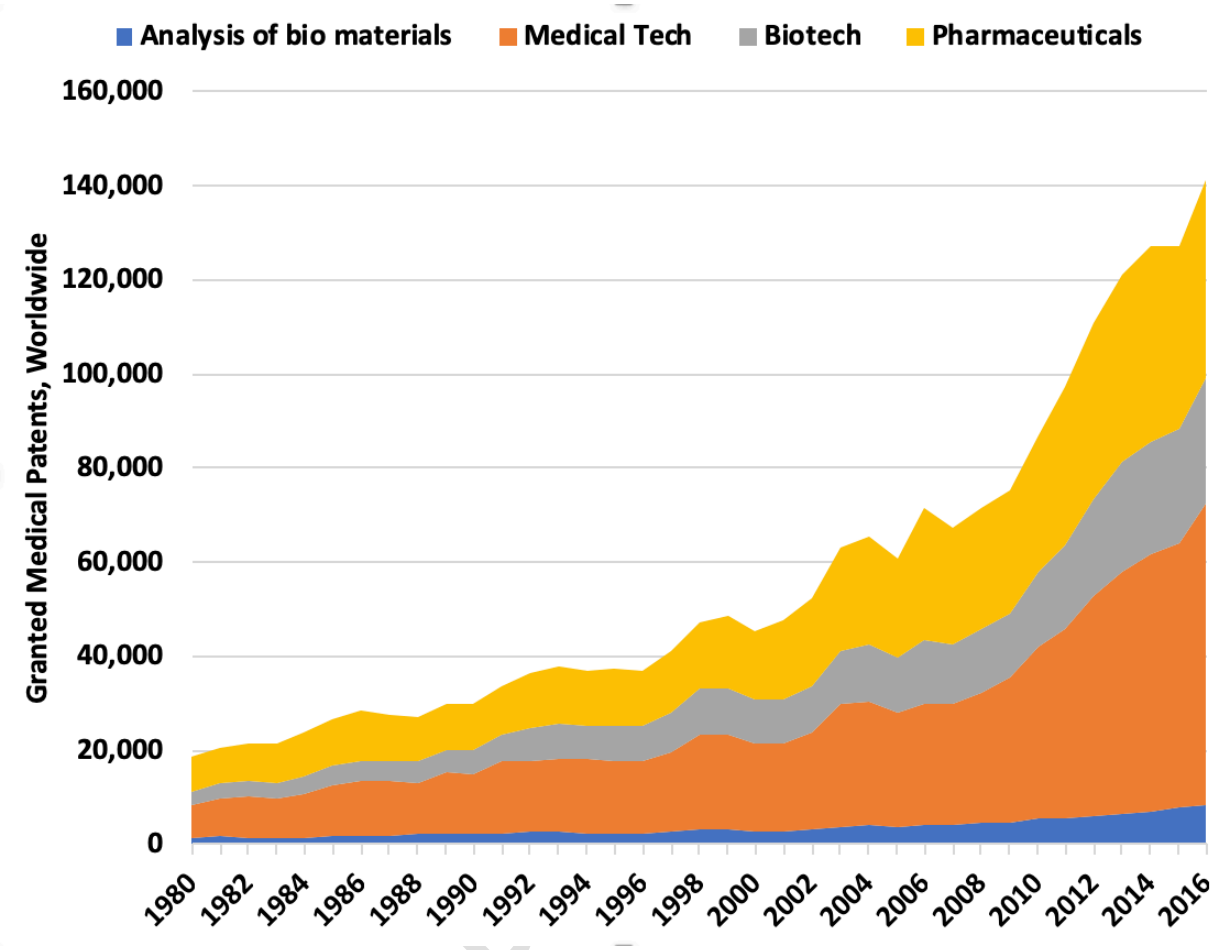
How can society expand access to therapies and approaches that address the underlying root causes of anxiety, depression, and suicide? Is addressing unresolved trauma a cornerstone for responsive health care? Is social media a hinderance to well-being and health, a potential support to well-being, or both?

20. Medical/Health Innovation Accelerating

The pace of innovation in medicine and health continues to accelerate, raising issues of equal access ethics and risk assessment.

Topic Area:	Technology
Trend Drivers:	Snowballing of human knowledge; development of supporting technologies; convergence of additional technologies; increasing private R&D funding; rise of new technology drivers like China and the developing world
Nature of the Trend:	Increasing, accelerating/exponential trend
Description:	The pace of innovation in medicine and human health has been accelerating over time, driven partly by advances in supporting digital technologies. Over the last decade, digital advances have been matched in their effects on medicine and health by a rapidly expanding confluence of innovations including AI, 3D printing, nanotechnology, and biotechnology. The number of medical-related patents has grown by 730% since 1980, with almost one-quarter of that increase occurring between 2010 and 2016. These have included patents from categories such as analysis of biological materials, biotechnology, pharmaceuticals, and medical technologies. Multiple medical technologies, including DNA sequencing and medical imaging systems, have been closely following Moore's Law (increasing in speed at a doubling rate every two years), or surpassing it, suggesting even more rapid gains in the future. The rapid pace of technological advance is not always reflected in the wider medical field, however, as practices and systems take time to adjust to the new technologies. And the improvements in a technology's cost and performance aren't always reflected in cost reductions and greater efficiencies for the end user.

Trend Graphic:



Number of Granted Medical-Related Patents, Worldwide by Subtype, 1980-2016

Source:

World Intellectual Property Organization, https://www.wipo.int/ipstats/en/

Potential Downstream EIs in this report: "Extreme Longevity for the Few"; "Living Medicine"; "Personalized Medicine"; "Editing Out Addiction"; "Kids Curing Kids"

Things to Consider

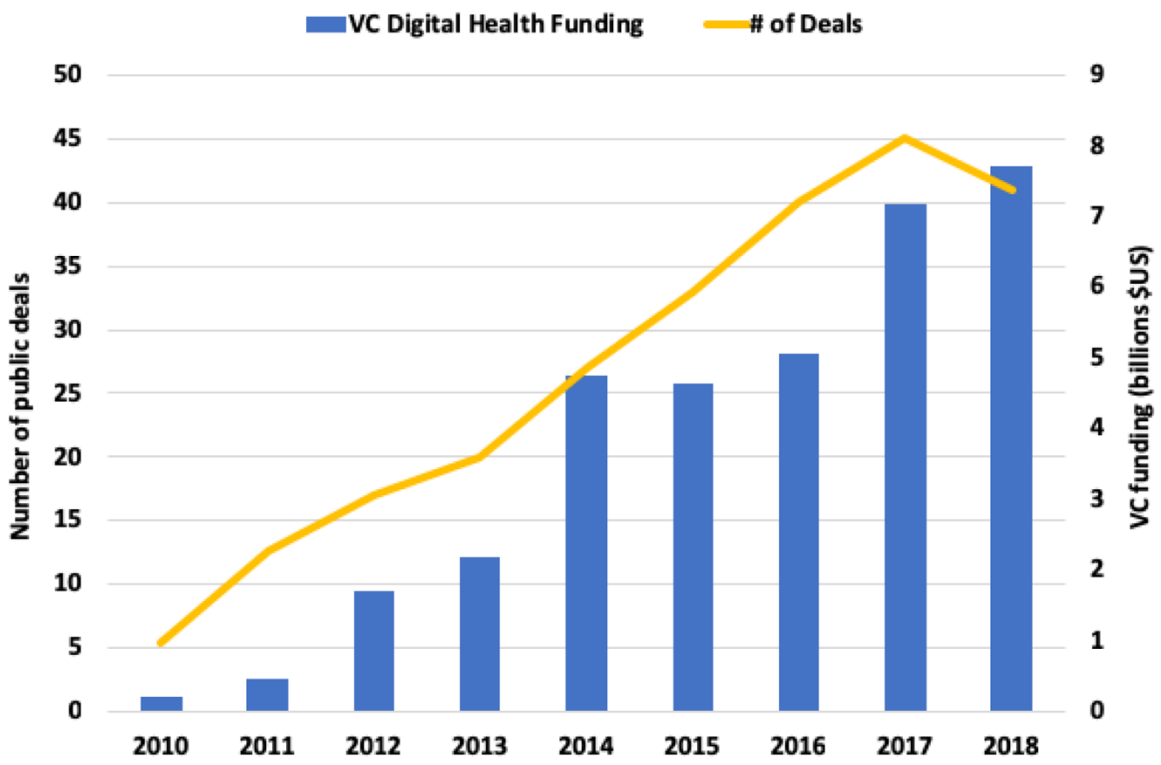
How can society ensure that tomorrow's medical advances are available to all? How can the medical/health industry more quickly adapt to changing technologies? How can society ensure adequate risk assessment and ethical evaluation of health innovations?

21. Healthcare Becoming Increasingly Digital and Distributed

From telemedicine to one-stop-shopping for health, the spread of smart, digital technologies into every aspect of life is also transforming the delivery of healthcare services.

Topic Area:	Healthcare System
Trend Drivers:	Entry of technology firms into the healthcare ecosystem; accelerating institutional investment into healthcare services; growth of digital technologies and social platforms; growth of e-commerce
Nature of the Trend:	Rapid, increasing linear trend
Description:	From telemedicine to one-stop-shopping for health, the spread of smart, digital technologies into every aspect of life is also transforming the delivery of healthcare services. Advancing technology, combined with accelerating institutional investment in health (private equity, venture capital, and hedge funds) and the entry of technology companies (Apple, Google, Amazon) into the ecosystem are driving the evolution of new business models and healthcare products. The results (so far) have been a push to provide more distributed health services by shifting care from traditional settings like inpatient, hospital-based care and outpatient medical clinics to retail clinics, home-based care, and telemedicine applications. Online and mobile apps have driven the rise of one-stop-shopping companies offering a full range of healthcare services from patient services to pharmacy to health insurance.

Trend Graphic:



Venture Capital Investment in Digital Health and Big Tech Participation in Healthcare

Source:

CBInsights, "The Future of Digital Health," https://www.cbinsights.com/research-digital-health-trends

Potential Downstream EIs in this Report: "It takes a Village"; "Turn Back to One Another: Rising Value of Care Work"; "Co-ops at the End of Capitalism"; "Automated Transport Networks"

Things to Consider

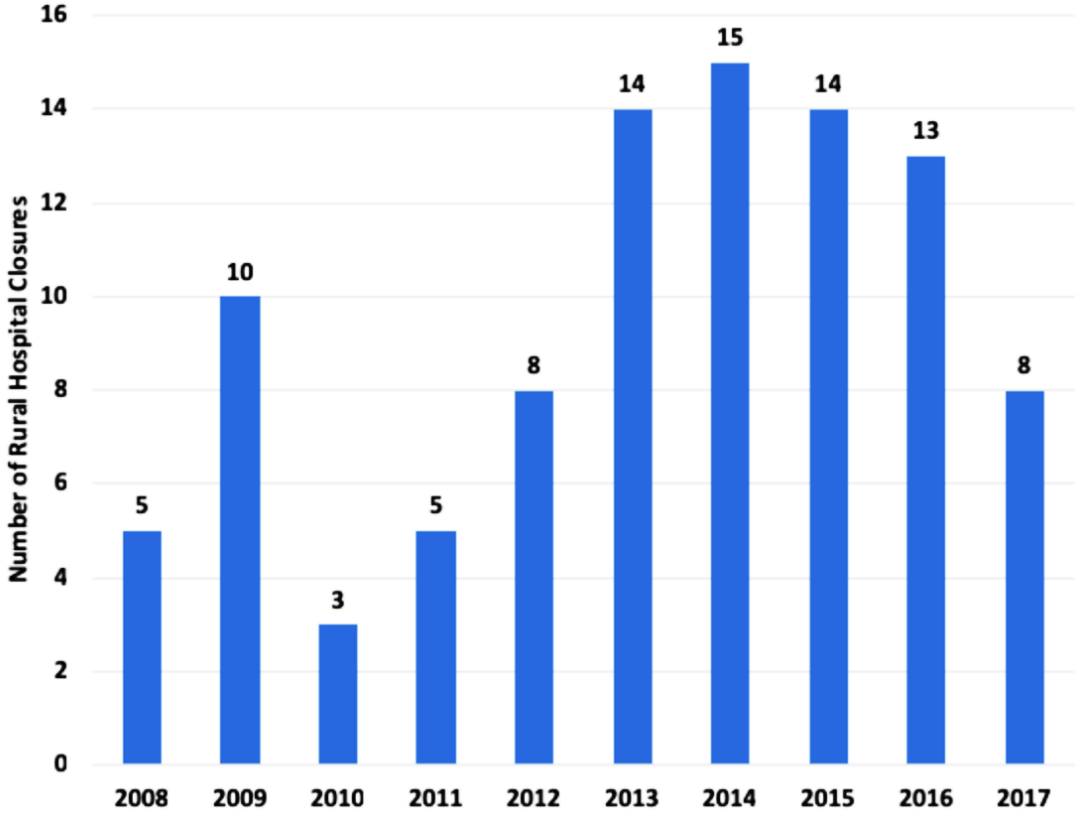
Patients are so far embracing the turn towards distributed and digital services, but can it go too far? Will patients long for a more traditional touch? How will the rise of gamification and personal quantification further transform the health ecosystem?

22. Expanding Health Deserts and the Urban/Rural Divide

The loss of rural healthcare providers is worsening existing disparities in health outcomes between rural and urban populations.

Topic Area:	Healthcare System
Trend Drivers:	Urbanization; consolidation of hospitals; Medicare cuts; difficulty recruiting medical specialists for rural areas; income inequality; educational inequality
Nature of the Trend:	Increasing linear trend for hospital closures as well as many mortality rates
Description:	Rural areas in the U.S. are increasingly becoming health deserts: areas where access to health services is more difficult and health outcomes are worse than in urban areas. People living in rural areas today face higher rates of mortality from heart disease, cancer, injuries (including overdoses), chronic lower respiratory disease, and stroke. They also experience higher infant and maternal mortality, and greater rates of suicides and mental health issues than those living in urban areas. This divide may be due in part to people living in rural areas being older, having lower incomes and formal education levels than urban areas, all of which are correlated with worsening health outcomes. But reduced access to health care services is another major factor. Ninety-five rural hospitals have closed since 2008—with 64 in just the past five years. The closure of such hospitals disproportionately affects low-income and elderly rural residents. The hospital closures are due in part to the reduction of Medicare payments and are concentrated in states that have not expanded Medicaid. Along with hospital closures, it is becoming increasingly difficult to find doctors and other health specialists willing to work in rural areas. In 2017, there were only 30 medical specialists per 100,000 people in rural areas compared to 263 specialists per 100,000 people in urban areas. The difficulty in accessing health care services and reduced economic opportunities in rural areas is also exacerbating the opioid crisis. Overdose death rates in rural areas are 45% higher than in urban.

Trend Graphic:



Nationwide closures of rural hospitals, 2008 to 2017

Source:

US GAO, 2018. "Rural Hospital Closures: Number and Characteristics of Affected Hospitals and Contributing Factors." https://www.gao.gov/assets/700/694125.pdf

Potential Downstream EIs in this Report: "It takes a Village"; "Turn Back to One Another: Rising Value of Care Work"; "Co-ops at the End of Capitalism"; "Automated Transport Networks"

Things to Consider

How can the U.S. ensure that rural areas have access to conditions for health and well-being? Is technology like telemedicine and drone delivery become part of the solution?

Anticipating Future Change

Anticipating change combines three activities: forecasting, based on extrapolating quantitative trends data; emerging issue identification, based on scanning for weak signals of change; and pattern identification of potential disruptive combinations, as trends and emerging issues interact and amplify each other. This section begins with forecasts generated by extrapolating potential outcomes of some historical trends similar to those described in the previous section. It then identifies and describes a set of 51 emerging issues that could drive change. As a first step in sensemaking, it then proposes ten disruptive combinations as a thought exercise in how colliding changes might create significant impacts.

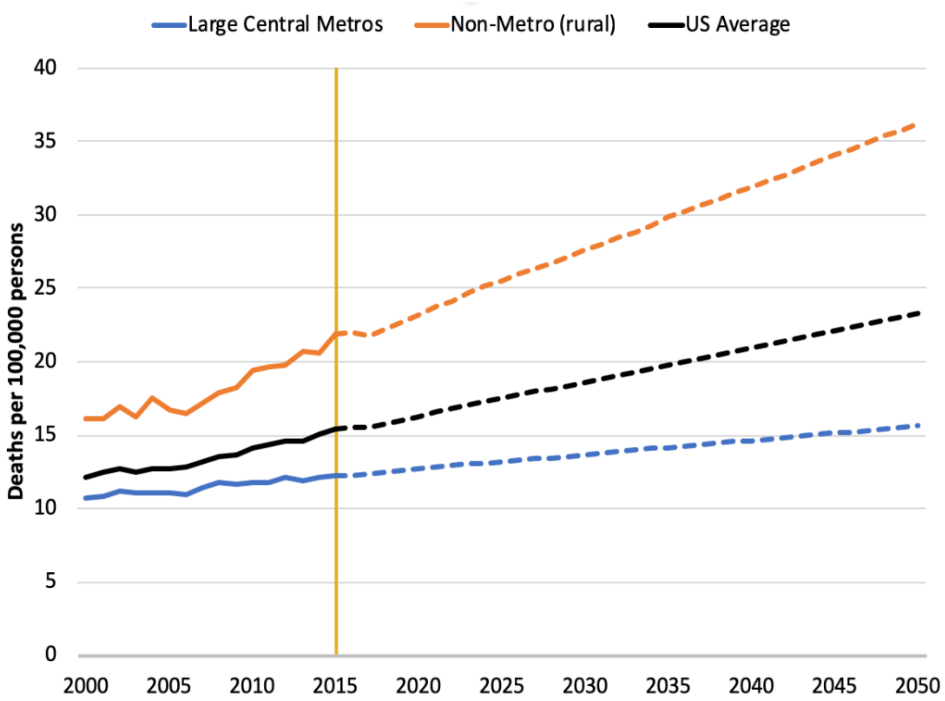
Trend Extrapolations[1]

While trends represent historical patterns of change over time, they can also serve as indicators for potential future developments based on what is known as the momentum of change. In general, the forces behind a measurable trend will continue over time unless significant change alters the direction. One of the first steps in assessing current signals of change, therefore, is to examine the implications of today's trends continuing along current trajectories into the future. Trend extrapolation represents a simple extension of a given trend using regression analysis to determine future 'forecast' values. Such extrapolations form the heart of Base Case forecasts—a no surprise forecast of the future where current trends continue, and no disruptive events occur.

Extrapolating from today's trends, the U.S. appears to be entering a period of increasing stressors and complexity, where worsening inequalities (wealth, income, health, and housing) and deteriorating health outcomes (lifestyle diseases, maternal mortality, mental health, lifespans) combine with environmental hardships (climate crisis and biodiversity loss) to challenge the country's resilience just as it goes through a significant generational shift (increasing diversity, liberalism, rising secularism, changing life stages) and rapid technological change—perhaps suggesting a new generation with new tools might bring new solutions to these challenges.

[1] The extrapolative forecasts shown in this section were calculated using least squares regression of recent values. Such 'straight-line' forecasts assume the current trend continues and that all else remains equal.

1. The Widening Chasm of Urban versus Rural Health Equity Outcomes



Suicide Rates (deaths per 100,000 persons) by Urbanization Level and National Average, History and Forecast, 2000 to 2050

Source:

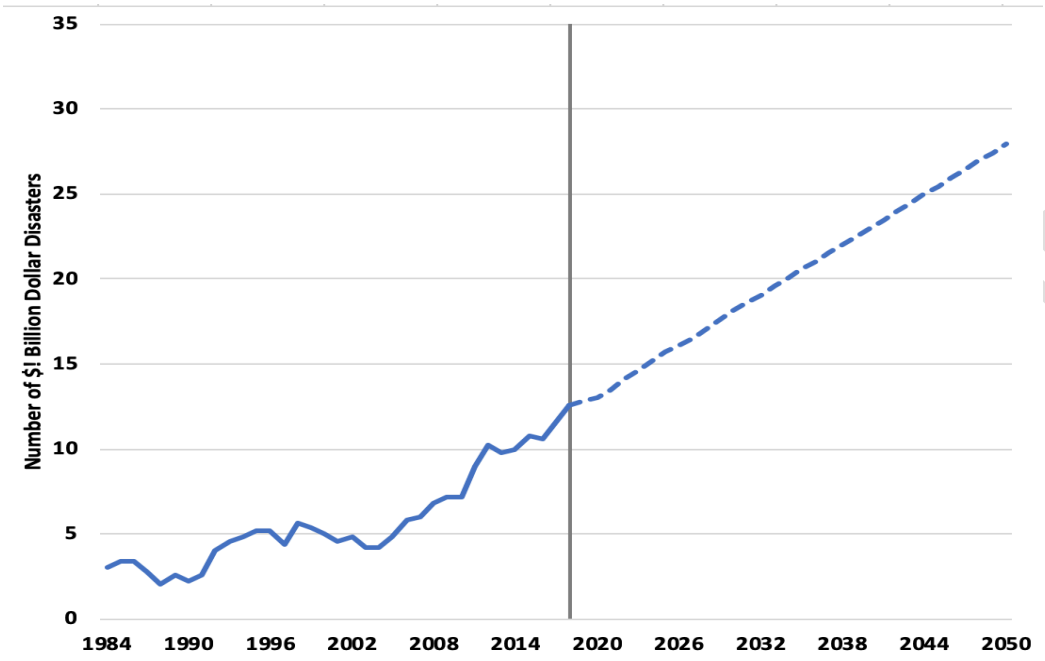
Historical data from CDC, 2018. "Suicide Mortality in the United States, 1999-2017." *https://www.cdc.gov/nchs/products/databriefs/db330.htm*

Description: Rural residents experience higher rates of morbidity and mortality than people living in urban areas. Rural residents also face more financial hardships and unemployment than urban residents. Suicide rates by urbanization levels is a good proxy measure of urban/rural socioeconomic and health divides because they are closely correlated with income, education level, health outcomes, and age. The graph above shows the history and forecast of suicide rates in the US. They have increased across since 2000, but at a significantly higher rate for rural residents than city-dwellers. If this trend continues, the rate for rural Americans in 2050 will be 36 per 100,000 persons; this is 65% higher than in 2015 and equivalent to Russia's 2018 suicide rate which is currently the highest in the world. In comparison, urban residents in 2050 are forecast at 16 per 100,000, about equal to the U.S. average in 2015.

Importance: The suicide rate is a good proxy measure for a population's physical and socioeconomic health.

Takeaway: Under current trends, rural populations are likely to see suicide rates rise significantly, indicating worsening physical and socioeconomic health.

2. Increasingly Frequent and Costly Weather-Related Disasters



Number of Billion Dollar Disasters in the US, History and Forecast, 1984 to 2050 Five-year moving average

Source:

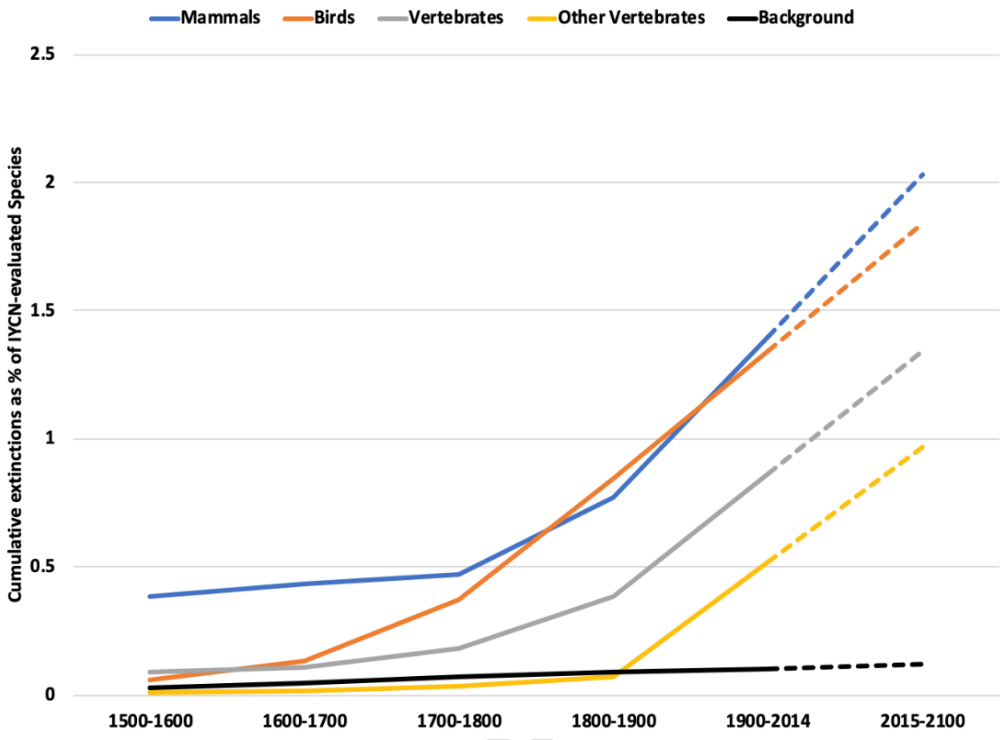
Historical data from NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2019)
https://www.ncdc.noaa.gov/billions/

Description: Both the number and cost of weather-related disasters affecting the U.S. have increased significantly since the 1990s. Several in the last few years now number among the costliest in U.S. history. Current trends suggest that weather-related disasters will continue to increase in frequency and cost, due both to worsening climate crisis and to continuing population growth in vulnerable areas (coastlines, floodplains, and areas susceptible to forest fires). Over the last five years, the average annual cost of climate events hitting the U.S. was over $12.6 billion per year. By 2050, if the current trend holds, the U.S. could suffer as many as 28 severe weather-related disasters per year (including floods, storms, droughts, wildfires, and heatwaves), representing significant economic damage.

Importance: The frequency and cost of weather-related disasters are a good proxy measure for both the 'strength' of the climate crisis and the society's vulnerability to climate change over time.

Takeaway: The number and cost of weather-related disasters are likely to increase in the future due to the combination of the climate crisis and population growth in vulnerable regions.

3. Accelerating Biodiversity Loss



Species Lost to Extinction Compared to Expected Background Rate, History and Forecast, 1500 to 2100

Source:

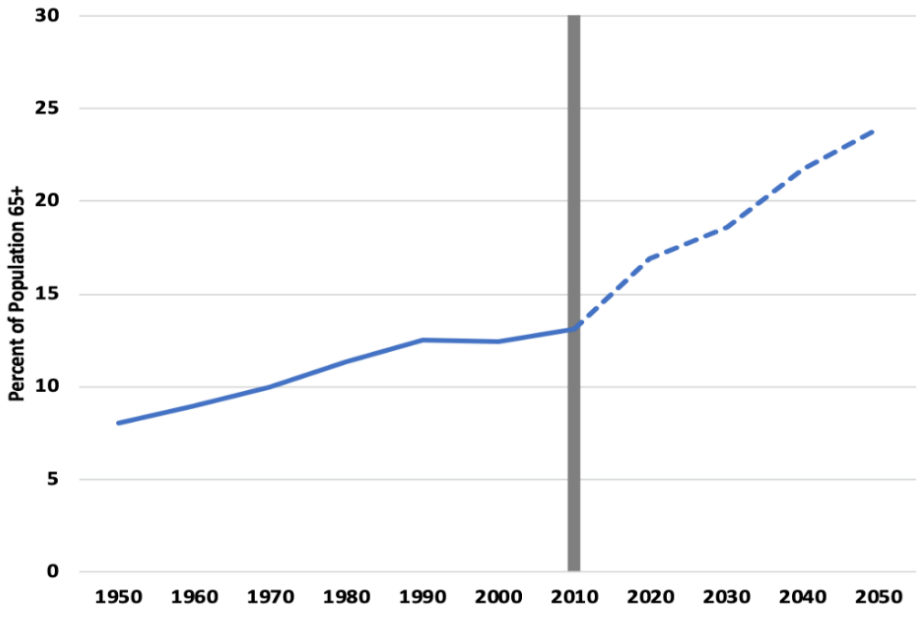
Historical data from Ceballos, Greardo et al. 2015. "Accelerated Modern Human-Induced Species Losses: Entering the Sixth Mass Extinction." Science Advances 19 https://advances.sciencemag.org/content/1/5/e1400253/tab-figures-data

Description: Population growth, the spread of consumerist lifestyles around the world, and the worsening climate crisis are all increasing habitat loss, resulting in growing species extinctions. Studies estimate that the current species extinction rate is as much as 1,000 times higher than the background rate. Extrapolation of this trend suggests that species loss will continue to increase over this century, with the steepest losses among mammals and birds. This assumes that many of the drivers of species loss will continue to increase. Existing forecasts estimate that roughly 30% to 50% of all species could face extinction by 2050.

Importance: The background extinction rate provides a measure of the 'normal' pace of extinction one would expect in a healthy biosphere—the higher the 'real' extinction rate is compared to the background, the more damaged or disrupted the biosphere.

Takeaway: Species loss across all forms of life is accelerating, bringing potential ecosystem collapse closer.

4. Rising Burden of Population Aging



Share of the US Population Above the Age of 65,
History and Forecast, 1950-2050

Source: *Historical data from World Bank World Development Indicators, 2018*

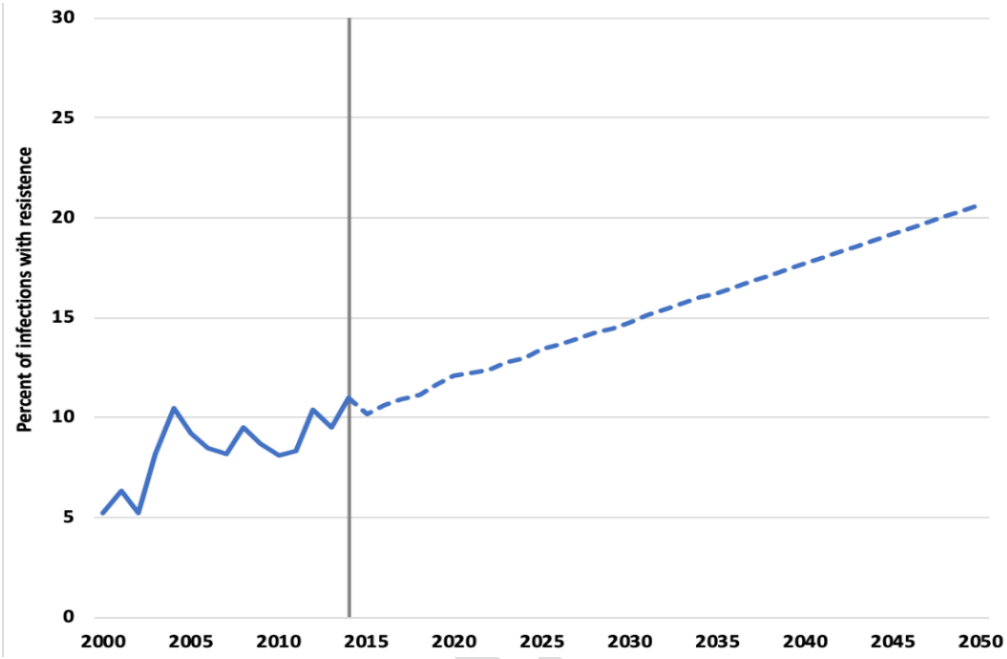
Description: Populations in developing countries around the world are aging rapidly due to falling birthrates and increasing life expectancy. In the U.S., high levels of immigration have contributed to a slightly younger population than in many other developed countries, but this boost is fading, and the U.S. population is aging. Currently, 14.9% of the US population is over the age of 65. By 2030, this share will reach 20% of the population. By 2035, the number of people aged 65 and over will outnumber the number of people under 18 for the first time in U.S. history. The U.S. median age is also increasing. Today, the U.S. median age of 38.1 years. By 2060, the U.S. median age will reach 44, raising the U.S. into the top 15 oldest countries (U.S. 2060 population would have a similar median age to Austria, Hong Kong and Greece today).

Importance: Population aging can be a significant burden for a society. The resources to support an aging population often increase just as the number of young workers declines. The weight of the burden is influenced by other trends, such as chronic disease rates and retirement age.

Takeaway: Current trends point to an older, sicker population creating a significant economic burden. Technological and medical advances could reduce the burden by

keeping people healthier, while automation could generate economic growth. Increased immigration could also lessen this burden by providing more young workers.

5. Reign of the Super Bugs



Percent of US Bacterial Infections Showing Antibiotic Resistance, History and Forecast 2000-2050

Source:

Historical data from Center for Disease Dynamics, Economics and Policy, https://resistancemap.cddep.org/AntibioticUse.php

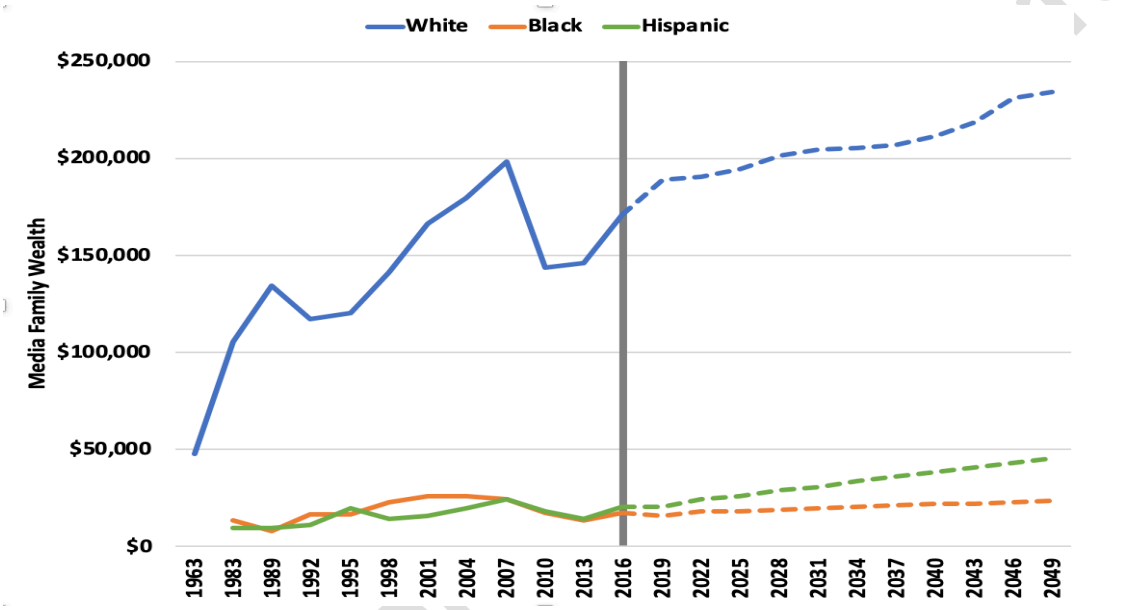
Description: Antibiotic resistance worldwide is rising, driven by overuse of antibiotics in the developed world (both for human health and agriculture) and increased use in the developed world (where overall access is still lacking). Some strains of bacteria are now immune to all known antibiotics. Today, roughly 11% of bacterial infections treated in the U.S. show signs of some antibiotic resistance, double the percentage in 2000. Should the current trend continue, some 20% or more of U.S. infections may become resistant to treatment, resulting in thousands of more hospitalizations and deaths per year. This trend is likely to continue due both to increasing antibiotics use in the developing world and to the slowing pace of new antibiotics being brought to market. Existing forecasts suggest that by 2050 some 10 million people could die from resistant infections worldwide.

Importance: Antibiotics are a lynchpin of modern medicine. The spread of antibiotic resistance could significantly undercut modern health gains by making even the most

routine surgery potentially deadly, especially as resistant infections are increasingly acquired in hospitals.

Takeaway: The current trend toward increasing antibiotic resistance can be stopped and even reversed through a) prioritizing the development of new drugs; b) reducing use in agriculture; and c) better guidance on their use.

6. The Wealth Gap Yawns Wider



Median Family Wealth by Race/Ethnicity, History and Forecast, 1963-2016

Source: *Historical data from Urban Institute, 2017*
https://apps.urban.org/features/wealth-inequality-charts/

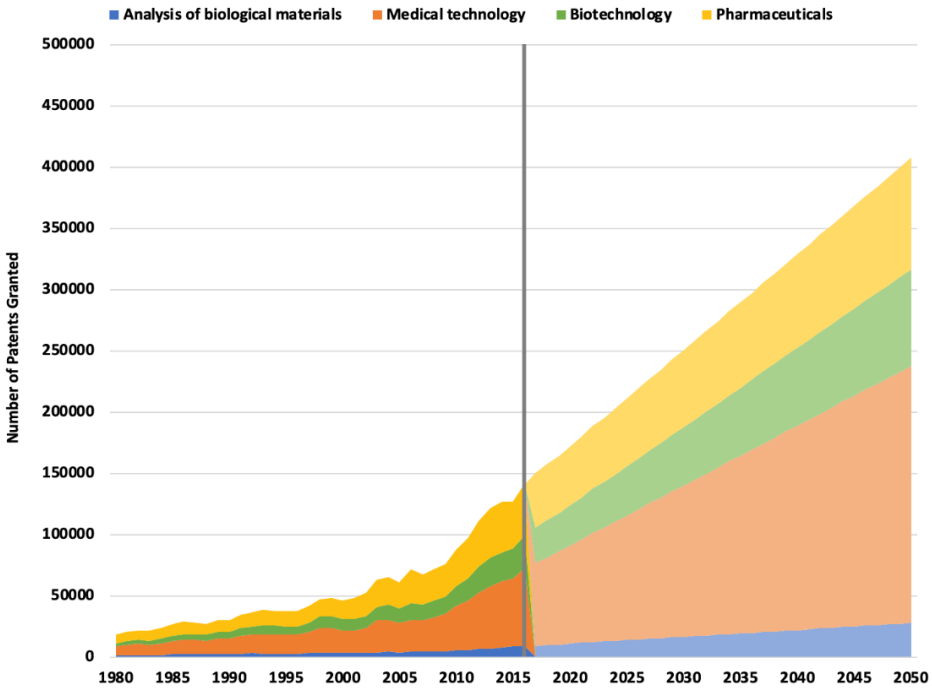
Description: White families continue to build wealth at a much higher rate and level than others, due to societal legacies creating systemic racist bias and policies. This wealth gap underlies many of the health disparities affecting non-white populations, especially lifestyle diseases. The current trend has seen white families almost quadruple their wealth between 1963 and 2016 while African American and Hispanic families saw significantly smaller gains (mostly wiped out by the 2008 financial crisis). Today, one in four African American households has zero or negative net worth, compared to just one in ten white households. Extrapolating the current trend yields two important findings: first, the median wealth of white families continues to grow faster than for non-white families, and, second, Hispanic families begin to outperform African American families. Existing forecasts are less optimistic than this straight extrapolation: many analysts expect African American and Hispanic families to lose

wealth over time (-18% for African Americans, -12% for Hispanics), and for the overall wealth gap to widen even more.

Importance: Family wealth is an extremely good proxy measure for how well individuals can access the resources needed to maintain a healthy life.

Takeaway: The wealth gap will continue to widen over time without policy intervention. Health disparities, especially rates of chronic diseases like diabetes will grow.

7. Much More Medical Innovation to Come



Number of Medical-Related Patents Granted, Worldwide by Subtype, History and Forecast, 1980-2050

Source: *Historical data from World Intellectual Property Organization, https://www.wipo.int/ipstats/en/*

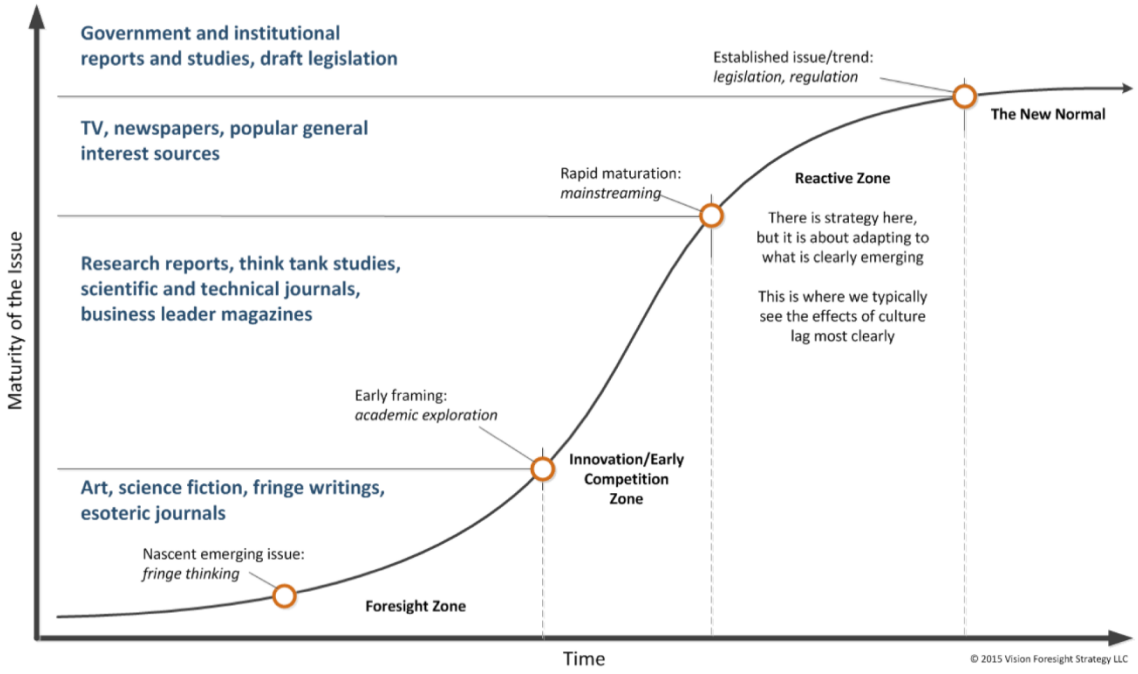
Description: The total number of patents filed each year continues to rise. In 2016 3million were filed worldwide, roughly double 2002 figures. The increasing number of patents filed and granted suggests: innovation continues to accelerate, and, the means of innovation are democratizing. The medical field has seen a similar surge in patents, with the number of granted increasing 740% between 1980 and 2016, with much of the growth driven by medical technology and pharmaceutical patents. Extrapolating the current trend suggests a massive increase in medical innovation, with 450% more patents being granted over the next 35 years (2015 to 2050) than 1980 to 2015. This may be an underestimate for medical-related patents, given the increasing number of discoveries and innovations in the biosciences.

Importance: The number of patents per year provides a decent proxy measure for the amount of innovation and development effort in the field. In particular, it can show where R&D efforts are concentrated and growing.

Takeaway: The number of medical patents granted in 2050 could triple the number granted in 2016, suggesting a massive amount of medical innovation is on the way, 450% more than occurred in the past 35 years.

Emerging Issues

In addition to the trend research, VFS conducted an environmental scan and emerging issues analysis to identify potentially important *emerging issues*. Driven by the pace of change and innovation, the next three decades will include significant shifts with wide-ranging implications for health and well-being. Emerging issues are valuable in foresight and strategy work because they enable organizations to identify opportunities and challenges *before* they become other people's competitive advantage, or before they arrive at the legislature for regulation. VFS uses its own version of the classic emerging issues s-curve to help locate emerging issues and address their potential.



For this project, VFS conducted a thorough horizon scan examining what drivers of change or emerging issues could come into play in the next thirty years. The scan was conducted across the following themes as agreed with the FORESIGHT leadership

- Equity
- Social Contracts
- Culture Shifts
- Economics
- Technology
- Demographic Shifts
- Healthcare Systems
- Climate Change

The following Emerging Issues were identified across the three zones of the S-curve.

Reactive Zone

1. The New Job Market
2. It Takes a Village
3. Mainstream Health Foods with Consequences
4. Marijuana Freedom
5. Mobilizing Menstrual Equity
6. Automated Transport Networks
7. Climate Crisis Impacts Health of Most Vulnerable
8. U.S. Economic Recession*
9. Sugar is the New Tobacco
10. Digital Alienation
11. Male Birth Control Pill
12. Increasingly Extreme U.S. Political Swings
13. Collapse of a Generation
14. Birthstrike
15. A New End of Life
16. Techno-Holistic Healthcare

Innovation Zone

17. Automation Driving Macroeconomic Reform
18. Diets as Medicine and Social/Ecological Justice
19. Elder Exploitation
20. Solving Waste Inequity
21. Personalized Medicine
22. End of Personal Privacy
23. Turn Back to One Another: Rising Value of Care Work
24. Climate Migrants and Adaptation
25. An American Authoritarian State
26. Digital Countries
27. Death of Pricing
28. End of Abortion Rights

29. End of Meat in Global Food Supply
30. Disparity of Climate Crisis Impacts on Food Supply
31. Data Sovereignty
32. Radical Transparency
33. Ending Pain and Anxiety Through DNA
34. Zombie Viruses and Toxic Threats Emerging from Melting Permafrost
35. Ready Player, Escape
36. Techno-hubris in Health
37. Humans Training Machines to Train Humans
38. Biased Algorithms
39. A Changing Understanding of and Response to Racism

Foresight Zone

40. “Everywhere” Living Online
41. Extreme Longevity for the Few
42. Machine Charities
43. World without Money
44. Living Medicine
45. Demographic Assumptions Overturned
46. Co-ops at the End of Capitalism
47. Redefining Childbearing
48. Runaway Microbial Tribbles
49. Zoonotic Outbreaks the “New Normal”
50. Kids Curing Kids
51. Editing Out Addiction

	Foresight	Innovation	Reactive
Surface	41. Extreme Longevity for the Few 42. Machine Charities 44. Living Medicine 49. Zoonotic Infection 50. Kids Curing Kids 51. Editing Out Addiction	17. Diets as Medicine 19. Elder Exploitation 21. Personalized Medicine 22. End of Personal Privacy 23. Turn Back to One Another 27. Death of Pricing 35. Ready Player, escape 36. Techno-hubris in Health 37. Humans Training Machines to Train Humans	1. The New Job Market 2. It Takes a Village 3. Mainstream Health Foods with Consequences 4. Marijuana Freedom 10. Digital Alienation 12. Increasingly Extreme US Political Swings 13. Collapse of a Generation
Systems	45. Co-ops at the End of Capitalism 46. Redefining Childbearing 47. Runaway Microbial Tribbles	20. Solving Waste Inequity 24. Climate Migrants Adaptation 25. An American Authoritarian State 28. End of Abortion Rights 29. End of Meat in Global Supply Chains 30. Disparity of Climate Crisis Impacts on Food Supply 34. Zombie Viruses and Toxic Threats 38. Biased Algorithms 39. A Changing Understanding of and Response to Racism	5. Mobilizing Menstrual Equity 6. Automated Transport Networks 7. Climate Crisis Impacts Health of Most Vulnerable 14. Birthstrike 16. Techno-holistic Healthcare
Worldview	40. “Everywhere” Living Online 41. World Without Money 43. Demographic Assumptions Overturned	17. Automation Driving Macroeconomic Reform 26. Digital Countries 31. Data Sovereignty 32. Radical Transparency 33. Ending Pain & Anxiety with DNA	8. U.S. Economic Recession 9. Sugar is the New Tobacco 11. Male Birth Control Pill 15. A New End of Life

Table 1: Emerging Issues Sorted by Layer and by S-curve Zone

Reactive Zone

1. The New Job Market

More flexible work arrangements 'gigifying' the job market with implications for the future of work.

Topic Area:	Social Contract
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Economic Inequality; US Economic Recession; Sharing Economy; Increased Automation
Dynamics of Change:	Economic cycles, boom and bust, recessions

An increasing number of Americans are transferring out of secure, permanent, salaried or hourly wage jobs into less secure "gig" arrangements. The gig economy can encompass everything from driving passengers to the airport, coding new VR games, or filing paperwork for a mega-conglomerate. These jobs are usually temporary contracts that give employees flexibility to work their own hours, but the pay is low, the benefits non-existent and employment security totally lacking. Gig employees are less expensive than regular employees as they are not subject to employment laws and protections. These lowered costs can help small businesses stay afloat through economic downturns, and help large multinational corporations maximize profits by cutting benefit costs. Even professional occupations, such as teachers, doctors, and lawyers, may increasingly be "gig-ified," as is evident by universities' increased use of adjunct faculty.

Many people like the flexibility of working and defining their own hours. However, low wages, low job security, and the lack of healthcare provision or unemployment insurance add stress to daily life. Policy makers in Europe and the U.S. are working to establish systems to secure workers' benefits within the gig economy. Gig workers faced with poor pay are unionizing in novel ways in attempts to improve their situation. In a related trend, progressive companies are learning from the popularity of gig arrangements and adapting their employee arrangements to support better work-life balance, remote working and flexibility to maintain a productive, motivated work force.

Things to Consider

Will this flexible employment lead to greater job satisfaction? Will fluid working arrangements amplify work stress? What impact might the debate over the gig economy have on traditional workplaces? How would health insurance work in a system where it was not required as part of employment law?

2. It Takes a Village

A new kind of communal living replaces the nuclear family.

Topic Area:	Culture Shifts
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Growing divorce rates; rising housing costs; increasing loneliness and anxiety rates; changes in working patterns; decreased birthrates
Dynamics of Change:	New perspectives drive value shifts which transform cultural structures and economic models

Divorce rates in the U.S. have been high for decades. Partly in reaction to this, people are opting to avoid marriage. Others are opting to avoid relationships completely and live a single life. Some adopt less traditional forms of relationships, such as open or polyamorous relationships, or are choosing to raise children without a partner. This shifting relationship culture is combining with high housing costs, changing working practices, and the sharing economy to create different living arrangements.

In 2018 and 2019 the number of purpose-built communal living rental properties massively increased: *Common* opened properties in five U.S. cities; and *WeLive* raised more than a billion dollars to build 10.3 million square feet of similar properties. These differ from traditional bedsit, studio or shared housing rentals, as they focus on shared recreation and working areas. While shared housing has traditionally been used by young people who aspire to move to their own home, these new designs are becoming a long-term lifestyle choice. People are also opting to share large houses in non-traditional family or commune arrangements to help with living costs, childcare, and to avoid loneliness. It is not just the young making this shift in living; 2018 saw an increase in retirees getting divorced and opting to move to shared living arrangements for company and to help with rising living costs.

This emerging change is driven by rising living costs, piecemeal working arrangements, and growing levels of anxiety and loneliness. Additionally, social media facilitates the formation of interest-group communities: people can more easily find like-minded friends with common views on topics from diet to spirituality.

Things to Consider

What could communal living mean for home ownership and mortgages? Could an increase in such living arrangements reduce levels of anxiety in the population? Could

community childcare arrangements increase equality for women in the workplace? Could birth rates begin to increase once more?

3. Mainstream Health Foods with Consequences

Mainstreaming health food invigorates alternative health movements and encourages unregulated urban farming, both of which could lead to disease outbreaks thought to have been left in the past.

Topic Area:	Culture Shifts
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Urban farms; anti-vax; healthy living; commercialization; losing faith in expertise
Dynamics of Change:	Strengthening conduits for the spread of memes that risk health as well as recreating old conduits for the spread of germs could amplify health dangers

Amazon's purchase of Whole Foods in 2017 represented peak commercialization of the trend toward healthy eating and healthy living. This market growth illustrates how some consumers have shifted to more health conscious and environmentally friendly food choices – even though they are usually more expensive. The "Amazon-ification" of the health food industry exemplified consumer-driven change. The Amazon-Whole Foods merger will increase the reach of Whole Foods and thus the marketing of "healthy," "clean" products such as fluoride-free toothpaste that is organic, non-GMO, paraben-free, and gluten-free.

A rise in movements such as shop local, food sovereignty, and the impact of food production on climate change helps amplify this extended reach for healthy lifestyle products. Urban farms fertilized by aquaponics (fish fertilization systems) and stocking micro-cattle, goats, chickens, etc. are popping up across U.S. cities. These urban farms can produce food locally but can also drive up house prices in already expensive cities, increasing the number of people experiencing homelessness and dependent on food banks. Further, the lack of regulation of urban farms run by amateurs can lead to poor sanitation, which risks spreading communicable diseases through populations less protected by advances in medicine, potentially causing outbreaks of diseases not seen for years in developed urban populations. The potential risk of disease outbreaks is compounded by the spread of alternative healthcare views, which include anti-vaccination beliefs and practices.

Things to Consider

How might urban farms affect the food supply chain? What will the future of agriculture in the U.S. look like? How could disease prevention be communicated more effectively to counteract misinformation?

4. Marijuana Freedom

Legalization supported by effective policies could reduce forms of inequality in society.

Topic Area:	Equity
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Marijuana legalization in many states; harm reduction policy success globally; growing legal marijuana industry
Dynamics of Change:	Redefining outmoded concepts to spark transformative change

The U.S. has the largest prison population in the world. U.S. drug policy has resulted in larger numbers of Latinx and black communities incarcerated on minor cannabis supply or possession charges than whites. A few of the factors contributing to this inequality include police and judicial prejudice; welfare policy; compounded by a long history of racist policy implementation through successive generations. Many pundits argue that the legalization of marijuana in many states will dramatically reduce incarceration on drug offences. Others argue that the grey economy has simply shifted to different illegal substances, and cannabis as a business has now moved beyond the reach of this section of society leading to yet more inequality. In contrast, Oakland reserves legal cannabis business permits for those with previous cannabis drug charges. This enables the victims of criminalization to benefit from legalization. Federal legalization supported by such a policy across the U.S. could significantly improve opportunities for this marginalized and previously incarcerated population.

After legalization, many states are releasing inmates serving marijuana-related sentences and slowly expunging those charges from criminal records. Removing charges from records is giving people a second chance. Instead of criminal records forcing them into low paid, dead-end jobs, career opportunities remain open to them. Policies enabling people with cannabis related crimes to benefit directly from cannabis business opportunities could transform their lives. Reducing stigma could help change attitudes and shift policies to support harm-reduction programs; to decriminalize more substances; and to provide help and support in the face of substance abuse. Global policy examples such as those of Portugal demonstrate that these approaches reduce prison populations and crime rates; improve health and well-being in the community; and reduce inequality. Legalization of marijuana in the U.S. could have a similar impact.

Things to Consider

How can the legal cannabis industry become more inclusive? What could be done to clear cannabis-related criminal records more quickly? Can equality come from decriminalization? How might harm prevention programs influence other areas of society?

5. Mobilizing Menstrual Equity

The current momentum of increased public awareness about "period poverty" offers an opportunity to improve support and guidance for individuals and families seeking government assistance.

Topic Area:	Social Contract, Equity, Culture Shifts
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Increased activity in support of removing the "tampon tax;" availability of free menstrual products in schools, shelters, and prisons; growing popularity of sustainable menstrual products; and the #MeToo movement
Dynamics of Change:	Social evolution to support vulnerable in society

Public interest has amplified around "period poverty" as a concern. This identifies menstrual equity as a significant health and well-being issue that prevents women from affording menstrual products and, by extension, obtaining education and employment. Charities and businesses are responding to public concern through programs providing menstrual products and education to women living in poverty. They are campaigning to remove the tax on tampons to reduce their cost. However, U.S. policy fails to acknowledge the impact of menstrual inequity on the U.S. workforce. A repeal of the "tampon tax" and increased availability of free menstrual products in certain institutions does not address the broader health and well-being impacts of period poverty on low-income women. Menstrual inequity creates a barrier to work and education and is a critical missing link in current public policy to assist women generally, with emphasis on low-income women. Rising awareness of this previously taboo issue could contribute to positive policy change and improve quality of life, employment opportunities, and health and well-being.

Things to Consider

How will policies on menstrual equity change current governmental subsidies and workforce policies? If these changes are made, in what ways might government try to control the kinds of menstrual care and products a woman elects to receive? Are there other ways in which the "period poverty" movement indicates a culture shift toward an understanding and acceptance of the impacts of menstruation on the well-being of women?

6. Automated Transport Networks

Automated transport networks make transport safer and changes the role of commuting.

Topic Area:	Technology, healthcare systems
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Artificial Intelligence; climate change; increased automation; autonomous vehicle advances; 5G; IoT, distributed renewables
Dynamics of Change:	Advances in transportation often transform and disrupt other aspects of culture and life

Autonomous cars could be safer than human-operated cars significantly reducing or eliminating traffic accidents. A reduction in road traffic accidents could reduce the burden on healthcare systems but would also reduce organ donations. The transformation created by autonomous transport networks could reach much further than improved safety. Self-driving technologies could change the nature of the daily commute. Time wasted "stuck in traffic" could now become time spent on other activities. This should reduce stress and the risk of road rage. With reduced accidents and without the need to accommodate driving comfort vehicle design will dramatically evolve. Many companies are already talking about integrated networks of transport pods capable of providing different rolling services such as restaurants, meeting rooms, workspaces, entertainment spaces, hotel rooms, gyms, shops or even doctor's surgeries.

These changes are not limited to urban environments and automotive transformations. Hyperloop transit systems – trains travelling in depressurized tubes capable of achieving speeds over 900mph – are being built in the U.S., Europe, and the Middle East to connect major cities. These high-speed mass transit systems are expected to be operational in the next ten years. France plans to switch to autonomous high-speed trains by 2023. Planes are also increasing in speed and size, both for passenger transit and cargo. The air, road and shipping industries are also transitioning to electric propulsion, harnessing renewable energy to reduce the need for fossil fuels. All these transport innovations could dramatically change our time spent commuting, and also how our cities themselves are structured and the accessibility of public services and healthcare.

Things to Consider

What sort of productivity increase could accompany this technology? How might the cargo industry adapt to automated vehicles taking the place of employees? Will there be an increase in rural development as commute times shorten and are no longer a burden? Can traffic fatalities be eradicated using this technology?

7. Climate Crisis Impacts Health of Most Vulnerable

Climate crisis health impacts will rapidly increase and challenge the preparedness of our healthcare system, and the poor will be disproportionately affected.

Topic Area:	Climate Change, Equity
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Forced migration due to the climate crisis; increasing severe weather events; growing cost of climate change
Dynamics of Change:	Environmental stresses disrupt stable social, economic, and political systems, driving evolutionary adaptation

While the climate crisis will affect the health of everyone, people who are poor or under-resourced are likely to feel the effects disproportionately. Low-income communities, both rural and urban, already suffer higher levels of adverse medical conditions such as cardiovascular disease and are more likely to be exposed to environmental pollutants. They are also least prepared for climate-related weather disasters and take longer to recover from them. This disparity will only grow with the increase in severe weather events, heatwaves, food and water supply shortages, water contamination, environmental degradation and pollution, increasing allergens, and changes in vector ecology (spread of diseases).

Evidence is mounting that climate-related impacts are already affecting the health of patients vulnerable to heat stress and to respiratory conditions like asthma. Blood borne tropical diseases are spreading to regions neither used nor prepared for them. Increasing numbers of people will be affected by mental health stressors, malnutrition and diarrheal diseases, asthma, cardiovascular disease, cholera and other water contamination illnesses. Forced migration due to the climate crisis (sea level rise, extreme heat, food shortages, and droughts) will likely overtax healthcare systems already under strain. Our health system needs to futureproof its ability to adapt to the climate crisis.

Things to Consider

How might innovative planning to respond to provide the best care for everyone as climate impacts advance? How can healthcare professionals encourage their local government officials to take the growing impacts of climate change seriously and to plan responses? How will communities care for the most vulnerable people?

*8. U.S. Economic Recession**

A growing number of observers and analysts are anticipating the (inevitable) turn in business and economic cycles.

Topic Area:	Economics
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Automation; austerity; trade wars and tariffs; globalization
Dynamics of Change:	Macroeconomics, boom-and-bust cycles

Cycles by definition include both ups and downs, and business cycles are no different. Despite a strong economy in 2018 with low unemployment, a growing chorus of voices is warning about a downturn in the U.S. economy. While America's current economic expansion is one of the longest in recent history, analysts are worried about signals like the recent U.S. Treasury bond inversion, which typically precedes recession. Forecasts suggest slower global growth in 2019, particularly in both China and the U.S. Tightening monetary policy in the U.S., volatile stock markets (responding in no small part to a continuing trade war between the U.S. and China), and rising debt are all contributing to analyst jitters.

Recent surveys of economists find forecasts for a U.S. recession by 2020 to cover a probability range of 35% to 50%. It is impossible to *predict* the timing and extent of an economic downturn exactly, but it is inevitable that it will happen. Given both the extensive duration of the current expansion, and the current turbulence across global and regional economies, a recession beginning in the 2019-2020 timeframe seems increasingly likely.

Things to Consider:

What are the immediate implications of an economic downturn? How have healthcare systems traditionally adapted to worsening economic conditions? What opportunities might the anticipation of a recession?

*Taken from NuVision Horizon Scan January 2019

9. Sugar is the New Tobacco

Significant scientific evidence on the health impacts of sugar gain momentum resulting in policies to ban its use.

Topic Area:	Healthcare, social contracts
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Research into importance of diet in health; growing health food movement; obesity epidemic; growth of prevention in healthcare
Dynamics of Change:	Health-driven policy and regulation of tobacco from promotion as a health product to blanket international ban

Scientific evidence has been growing regarding the detrimental effects of sugar in the diet. Nutritional studies have proven sugar to be addictive, to encourage overeating, and to heighten unhealthy weight gain. More recently, research has linked sugar to chronic illnesses such as diabetes as well as cancer, heart disease, and stroke. Government guidelines and policies have started limiting the amount of sugar that food manufacturers can include in products and have also required mandatory labelling specifying sugar content. Consumers are increasingly choosing to reduce sugar in their diet dramatically – sometimes completely. The number of cookbooks containing sugar-free baking alternatives has risen sharply, and sugar free sweeteners such as agave are growing in popularity.

According to CDC statistics, death rates from diseases such as cancer, diabetes, heart disease, and stroke have more than doubled in the U.S. since 1980. In 2016 over 100 million Americans were living with diabetes. This creates a significant burden for insurance companies and state health care services. Diabetes rates are disproportionately higher among people of color and in low-income communities, reflecting access to cheaper and poorer quality food which is often highly processed. Given the increase in obesity and obesity-related chronic diseases, it may be only a matter of time before more regulations attempt to limit sugar and sugary products.

A partial ban, modelled on the restrictions on tobacco, is not implausible. Health concerns also exist concerning artificial sweeteners and sugar replacement products. Such a change to the food industry could dramatically affect the distribution of health and well-being in communities across the U.S. – with potential impacts worldwide.

Things to Consider

What would the health effects of a zero-sugar diet be on U.S. populations? How would this affect the cost of food? Would certain industries be destroyed by such a policy? What new opportunities might arise? What would the impact be on global markets?

10. Digital Alienation

An increase in big data analytics, financial technologies, and smart technologies lead to alienation of certain sub-populations from society.

Topic Area:	Equity, Social Contracts
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Automation; big data; IoT; cashless payments; AI; blockchain; increased homelessness; aging population
Dynamics of Change:	Steady movement of change from analog to digital and from high street to internet

As transactions and services increasingly move online and into the digital realm, some people will become increasingly alienated from society. Most dramatically hit will be those already isolated or economically disadvantaged. This includes people who are elderly, recent immigrants, experiencing homelessness, experiencing mental health issues and unresolved trauma, and living in extreme poverty. For these groups, access to electronics and online services such as bank accounts or credit ratings are already out of reach. As big data platforms and the Internet of Things increasingly move data and services into the automated digital domain, more services will require consumer connectivity for access. This trend could amplify the isolation of disconnected, disadvantaged, and marginalized communities.

Health services are also increasingly digital and connected. Interconnected hospital, clinic, laboratory, and GP record systems are supported and augmented by big data analytics. People without access to these systems or lacking complete data from other services risk falling through the gaps of healthcare provision, further isolating and disadvantaging them. Designers of the digital healthcare systems of the future should bear these needs and contexts in mind to ensure access to and continuity of care.

Things to Consider

How might such isolation be avoided? What health impacts could such alienation have on marginal communities? How could this be monitored and better understood?

11. Male Birth Control Pill

Changing attitudes could lead to widespread use of a male contraceptive pill.

Topic Area:	Healthcare systems, social contracts, equity
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Personalized medicine; advances in medical technology; proliferation of DNA sequencing; stricter abortion laws; #MeToo; growing social conscience; changing U.S. culture
Dynamics of Change:	Progression of change in response to external forces, societal pressures and new technology

Millennials and Gen Z are becoming more socially conscious. Traditional patriarchal gender roles regarding childcare responsibilities are evolving. Men are more involved in childcare, taking on the role of primary care giver or opting for shared parental leave where possible. Greater equality between the sexes, same-sex couples, and single parents are changing the dynamics of responsibility for childcare and consequently for contraception. At the same time, more traditional, patriarchal sections of society are legislating for tighter abortion laws that limit both women's options in the face of unwanted pregnancy and also limit access to female contraceptive products and healthcare.

Clinical trials have been underway for some years to develop a male birth control pill, but side effects (similar to those caused by the female pill) prevented this product from coming to market. As attitudes change, as women have less access to birth control, and as men take on more responsibility, the demand for a male contraceptive could potentially grow. Without the difficulties associated with traditional gender roles, male contraceptives could be easier to obtain than women's contraception has historically been. This may reduce the number of unwanted pregnancies and improve socioeconomic conditions for some sectors of society.

Things to Consider

How might the religious community respond to such a development? If this pill decreases male libido would there be wider societal effects? What will this mean for equality? Might a male contraceptive pill cause an increase in sexually transmitted diseases? What impact could this have on sexual activities? What could the wider societal impacts be?

12. Increasingly Extreme U.S. Political Swings

Worsening political dysfunction as the swing between Republican and Democratic administrations creates ever-more-extreme polarization

Topic Area:	Social Contract
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	The U.S. electoral two-party system, increased political polarization, America's shifting faith landscape, increasingly diversity in the U.S.
Dynamics of Change:	Reactive political swings generate political backlash; oscillating dynamic

The U.S. two-party political system has always led to a degree of policy reversal when the administration changes from Republican to Democrat or vice versa. In recent years the gap between the political ideologies has widened with parties take harder lines on more issues. As the Republicans and Democrats fight out issues in the House and Senate, politics is increasingly characterized by the need to block the ruling administration from passing legislation or reversing it when the opposition takes back power. These politics of division stoke animosity between the parties and their electorates. These divisions will probably continue growing, fueled by the echo chamber of the media where people are increasingly able to hear validation of their opinions rather than facts. The current administration came to power on the back of a particularly divisive campaign which escalated this whipsaw policy approach. As this escalation continues longer and more regular government shutdowns could become common, and progress on policy issues could be stunted as decisions and funding are reversed every time the administration changes. The electorates might become more energized as polarization increases, which would only increase the frequency that administrations change.

The policy stalemate caused by worsening whipsaw administrations could destabilize all sectors of society. Infrastructure would decline from lack of funding. Reversed decisions would create instability impacting markets and international relations. Companies would need to put in place contingency plans to react to potential changes every four years, eating into their profit margins and making business very difficult. In the healthcare sector both insurance companies and consumers would face constant uncertainty on how and whether care would be funded and who was liable. Needless to say, low-income communities and middle classes would be hit hardest by this uncertainty, feeding further inequality.

Things to Consider

Can a unifying figure mend the fracturing U.S. psyche? How could state leaders mobilized for a more stable and productive future? How could systems of health and well-being safeguard against such risks?

13. Collapse of a Generation

Millennials reeling from the missed opportunities they have been dealt become a burden on society.

Topic Area:	Social Contract
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Growing mental health crisis, it takes a village, life stages moving later and out of order, widening wealth gap, growing inequality, rising suicide rates
Dynamics of Change:	Mounting disappointment

The Millennial generation have had a tough run. The 2008 financial crisis cost nine million people their jobs just as this generation was entering the job market. Many of those who had attended college have huge debts, but regardless of education level, many were left with no employment prospects. As a new business model, the gig economy created more jobs, but they were low paid, benefit-free and uncertain. Many Millennials joined the military in desperation, finding themselves in wars in Afghanistan and Iraq that left them with life changing injuries or unresolved trauma, reflected in higher rates of Post-Traumatic Stress Disorder. House prices rocketed, snatching the opportunity to ever own a house from most, and leaving many completely homeless. Financial stress, lack of job opportunities, much less job satisfaction, overall bleak life prospects, and the climate crisis have all increased daily stress and anxiety. Many Millennials are suffering depression or other mental health issues, and suicide rates are rising.

The scale of these challenges for Millennials could essentially create a lost generation of young adults unable to ever maintain viable employment or start families. This could affect the stability and shape of U.S. society. Birth rates as well as marriage rates are falling, and as the older generations age they could put significantly more pressure on healthcare systems and society that would lack the support from this lost generation.

Things to Consider

Can reasonable political policies be put in place to stop another market crash? How might the collapse of this generation affect younger generations? How could fortunes be reversed?

14. Birthstrike

Women delaying or not having children in fear of political turmoil and the climate crisis, precipitating demographic shifts.

Topic Area:	Social Contract
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Senior care, labor force, Medicare/Medicaid, mechanization/technology
Dynamics of Change:	Stimulus – contextual crises – and response; generational value shifts

With the climate crisis forecasting dire futures ahead, more women could question the ethics of bringing children into a dying world. Economic instability and political turmoil make even the near-term future seem uncertain. This raises the possibility of a growing "birthstrike" that will further contribute to an already declining birthrate. The aging of the population, with fewer younger people to support the elderly, will affect the labor force, Medicare/Medicaid, and senior care, forcing adaptive transformation.

Healthcare would need to focus more on keeping seniors as healthy as possible, for as long as possible, both to keep them in the workforce and to delay costs of eldercare. Automation in the workplace could help mitigate the prospect of an aging workforce but falling birthrates could dramatically impact demographics counteracting projected population growth and reducing pressure on global food systems.

Things to Consider

If people are forced to work later and later in life, what would be the impact on retirement planning and saving? How can planning for the climate crisis and more sustainable lifestyles take this changing demographic into account? What other implications could a declining birth rate have?

15. A New End of Life

New intersections between palliative care and the deathcare industry reducing cultural burial traditions.

Topic Area:	Culture Shifts, Climate Change
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Green burial options, environmental and social responsibility, increased longevity, public concern with unavailability and unaffordability of healthcare, aging population
Dynamics of Change:	Regulation and Governance

People are increasingly aware of the need to reduce their personal impacts on the environment. This awareness is expanding beyond merely lowering the amount of foods and goods they consume – and waste – to wider social issues, including end-of-life care and funeral services. This suggests that cultural views on the cost of both natural death and current forms of burial may shift. More people are taking a critical look at both the high cost and significant climate and energy impacts of long hospital stays, medical treatment, and senior care. This could push healthcare systems to address energy use and impacts of available forms of treatment, resulting in improved sustainability and accessibility of health services. Public interest in euthanasia as an option for non-terminal patients or the elderly to relieve their families of the financial burden of their care and to lessen their environmental impacts.

In either case, the current landscape of palliative care and deathcare services will intersect in new ways to accommodate consumers' preferences for their desired end-of-life experience. This will also encompass subsequent donation or utilization of their remains in ways that benefit the environment or society. These evolving perspectives on managing death could lead to a significant expansion of current green burial options. Entirely new kinds of burial grounds could evolve based on the use of human remains to develop green spaces through re-forestry, botanic gardens, wildlife reserves, coral reefs to name a few.

Things to Consider

What might end-of-life consumerism and event planning look like? What changes are necessary to make green burial options accessible and affordable? Will personalization of the death experience impact the language surrounding death,

policy development, and how it is documented by medical professionals for death certificates, medical records, etc.?

16. Techno-Holistic Health Care

All aspects of healthcare tailored just for you based on real-time data monitoring and analysis.

Topic Area:	Healthcare System, Technology
Zone:	Reactive Zone
Strength:	Maturing Development
Upstream TEI:	Further advancements in biometric readers from pedometers to implanted blood testers; big data used for public health diagnostics; crowdsourced science
Dynamics of Change:	Evolving technological systems and ecologies of apps create emergent possibilities to which social, economic, and regulatory systems adapt

Technological sophisticates and pundits are already using wearable technologies, environmental sensors, constant algorithmic scanning of health data, and artificial intelligence to regulate their personal health regimes. Public health researchers are already investigating how big data analytics of social media and other online content can reveal communication patterns that signal emerging flu or cold outbreaks and diagnose mental health or physical health conditions. Primitive forms of techno-health are already available, and monetized such as: *Apple Health*, *Fitbit*, *Health Tracker*. As these become more sophisticated and capable, they will attract more and more customers. Consumers will be continuously monitored by wearable technologies that record heart rate, ECG, blood oxygen, blood pressure, hormone and electrolyte levels. Central servers will use AI to analyze data and recommend changes to eating, exercise, and medications. These services could also include DNA testing to tailor individual health plans at a genetic level and maximize their effectiveness.

The effectiveness of these services will grow in time meaning they could contribute to an emergent ecology of health data combining with environmental quality monitors, global algorithms tracking health signals, electronic hospital and insurance health records, medical and public health research. The result could be a future public-health focused AI, coaching all of us to better health and well-being, dramatically reducing the costs of healthcare provision and improving access for low-income, rural communities.

Things to Consider

How much of a personal investment will these services require? Will this simply be a passing fad or permanently change the health and well-being landscape? How might public-health-focused Big Data analytics contribute?

Innovation Zone

17. Automation Driving Macroeconomic Reform

Massive inequality will drive government to transform domestic economic policies such as basic income and the end of services for profit.

Topic Area:	Equity
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Automation of jobs; wealth gap
Dynamics of Change:	Increased tensions and socioeconomic contradictions drive change

Wealth inequality has risen dramatically in the last few decades. This has prompted discussion of a universal basic income, that is, a regular payment from the government to every member of society. Economists predict inequality will rise even more sharply in the next ten years due to increased automation. One study predicts automation will eliminate 25% of jobs by 2030, which equates to 40 million jobs. In comparison, the 2008 financial crisis only resulted in 9 million lost jobs. Initially, the reduction in production costs could drive up profits, but this would probably be short lived as the number of customers with the means to purchase products drops dramatically. As profits decline with falling demand, the economy will spiral downwards, bankrupting small and midsized businesses and creating even larger corporate powerhouses.

A crashing economy in which 80% of the population are struggling without disposable income could transform the macroeconomic picture. In this context, the concept of a guaranteed basic income could become popular. Without economic activity to fuel the economy as it currently does, the government would need to use government funds to implement policies that drive economic growth. A state-fueled economy could change the economic landscape, with less focus on profit and on benefits to shareholders. Economic outcomes would focus more on service provision and population well-being. This could dramatically shift both the economic structure and the culture of the country.

Things to Consider

What could an economy supported by a government basic income look like? What would the implications be in the short and longer term on health and well-being?

What opportunities does this present for expanding health and well-being on an equitable basis?

18. Diets as Medicine and Social/Ecological Justice

Prompted by climate impacts and medical needs, the way people eat will increasingly be seen both as medicine and as necessary to address social inequality and the climate crisis.

Topic Area:	Culture Shifts, Equity, Climate Change
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Lab-grown meat/protein sources; urban farming; drought and climate resistant crops
Dynamics of Change:	Disruptive innovations combine to underscore and accelerate value shifts

The confluence of climate impacts, public health crises, and social equality issues suggest a shift in U.S. diet is increasingly necessary. The U.S. could look to other cultures, including their own indigenous ones, for models of eating that are easier on the environment, more sustainable, and healthier. Foods with the biggest climate footprints such as beef, lamb, cheese, should be replaced with climate-smart, sustainable proteins like lentils and beans. These diet adaptations would help society slow dangerous climate change and maintain food security for a growing population. Meat will be increasingly lab grown or 3D-printed – the success of the Impossible Burger introduced by Burger King signals a decline in U.S. resistance to beef alternatives.

Changes to the food supply chain, agricultural methods, and the American diet could significantly impact emissions and social conventions regarding food, and also result in a healthier diet across society. This would help to address chronic diseases affecting society like type two diabetes, stroke, heart disease and cancers. Many of these could be almost eliminated if the entire population had access to and adopted a healthier and more ecologically friendly diet. With today's high correlation between food deserts and low-income communities, a shift in the U.S. diet towards more sustainable, healthy, and less expensive food could produce significantly improved and equitable well-being and health across society.

Things to Consider

How will fad diets like keto and paleo affect this shift to more plant-based eating? Could classes and information sessions be incorporated into government sponsored food programs? How can local communities support local farmers as they switch from husbandry to plant crops?

19. Elder Exploitation

A significant increase in employed elderly who are unable to retire or afford senior care will lead to new forms of elder abuse and worker exploitation.

Topic Area:	Economics, Healthcare systems
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	More Americans unable to retire; increased cost of senior care and residential facilities; room for retired Americans to participate in the gig economy
Dynamics of Change:	Economics driving behavior

With rising costs of living and less secure job markets, it will become harder for many Americans to retire. This trend could cause new employment-based forms of elder abuse and exploitation. Industries that provide medical and housing coverage will need to be monitored to prevent unethical practices toward an aging workforce.

A potential form of employment-based elder abuse might mimic the traditional structure of work-study grants in higher education. In work-study schemes, college students would obtain on-campus jobs to pay for their tuition and fees. Following that model, participants at senior congregate living facilities might be required to perform on-site jobs to pay for their care as well as to alleviate the need for full-time staff. While it might have some benefits, this concept could easily be corrupted and threaten the health and well-being of the elderly participants. Another example derives from the growing gig economy: businesses could exploit the willingness of elderly job seekers and employees to accept contract work in exchange for healthcare or housing, leading to excessive work hours and physical and mental burnout. This could become a new form of modern indentured servitude.

Things to Consider

What policies are needed to protect the elderly from accepting unethical work arrangements in exchange for senior care? How can industry change current benefits packages to support longer careers and older employees? How will current elderly service programs evolve to address a growing elderly workforce?

20. Solving Waste Inequity

Pressure on waste management systems and environmental degradation could overwhelm structures requiring significant innovation to escape disaster.

Topic Area:	Climate Change, Culture Shifts, Equity
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Pollution; full landfills; plastic pollution; reduced Chinese market for recycling; mass consumerism
Dynamics of Change:	Political shifts create impacts throughout the system, forcing innovation and new paradigms

Trash disposal and landfills are usually sited far from affluent communities, disproportionately leaving low-income populations to deal with the health impacts of toxic landfills, industrial waste, and contaminated water. Waste disposal systems are vulnerable to climate disasters and increasing extreme weather could further threaten human health. China has stopped taking U.S. recycling, making waste disposal less profitable and harder to manage. Being awash in waste could have dire consequences for our communities and the planet. However, a culture-wide shift to reusables, waste efficiency, and adaptive innovations could significantly alter the role of waste, making refuse valuable, challenging paradigms for classifying waste as garbage, promoting better health, and lessening environmental impacts.

Things to Consider

How might local governments incentivize better recycling practices at a household level? How can medical providers and healthcare groups advocate for more responsible management of industrial waste to protect vulnerable citizens? How could government funding and tax initiatives fast-track innovative approaches to dealing with waste?

21. Personalized Medicine

From up-to-the second sharable health data to medication designed for your genes, all aspects of healthcare will be tailored just for you.

Topic Area:	Healthcare System, Technology
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Proliferation of DNA sampling services; genomic sequencing advancements
Dynamics of Change:	Technological changes drive new opportunities and reconsideration of old assumptions and habits

In the past, healthcare has been designed on a "one-size-fits-some" model. People take over-the-counter medication in doses recommended to an average male consumer. But two key innovations are moving the healthcare system away from this model. The first, is the use of personal health information. Wearable technologies that track users' movement, activity level, and heart rate are becoming more popular. As these technologies advance data collection will spread, and doctors will start to use it more effectively. Doctors will know how much patients really have been exercising, eating, and sleeping. The metrics will also provide real-time results of any new care regime the physician introduces, and they will be able to track effectiveness of doses of medication. All this information will help design personalized healthcare plans for each patient instead of vague suggestions based upon what works for some people.

The next innovation to personalize healthcare is genomic medicine. Using analyses from easy-to-access genetic testing services such as *23andMe*, healthcare providers can offer more personalized treatment plans to patients. An example is testing for BRCA1 and BRCA2 mutations that may be connected to breast cancer, as well as genetic testing for Alzheimer's disease. Pharmacogenetic companies are developing genetically unique medications for depression, anxiety, ADHD, and folate deficiency, as well as differentiated cancer treatments. Pharmaceutical companies are now beginning to engineer medicine that works more effectively for certain populations – or for only a single individual.

While exciting, these advances are, in their early days, expensive. People can expect that the healthcare gap between rich and poor will affect who receives these types of treatments and how widespread their impact will be. Appropriate policies and structures could prevent this and share the positive impacts across society.

Things to Consider

How will the doctor/patient relationship change with the introduction of personalized health data?

Will these services require a world of mandatory DNA testing? What could this mean for lowering healthcare costs? Could this create a world of preventative medicine?

22. *End of Personal Privacy*

In a world where people share their private lives online, how can anyone expect to keep personal affairs secret?

Topic Area:	Technology, social contracts
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Continuous monitoring of health data; increased cyber attacks
Dynamics of Change:	Cybercrime will always outpace cybersecurity. The expectation of privacy is eroding

News stories surrounding data breaches seem a daily occurrence. No company that does business online is immune: car companies, banks, hotels, and email hosts have all been in the headlines. But healthcare companies are also susceptible to hackers stealing patient information. While internet security continuously innovates, it will just as continuously be threatened by security breaches. Hackers constantly test whatever security countermeasures exist. Users are at risk from foreign powers, commercial entities, and hacking groups. They could even have their privacy threatened by their own governments. With everything moving online and big data driving more and more systems it becomes impossible to imagine a world where anyone can expect privacy of personal data.

China offers a dystopian view of how governments can use such information to control citizens. The Chinese government heavily monitors citizens' data under the auspices of security. Political dissent is tracked and punished. Websites are censored or blocked to prevent a free flow of ideas that may be counter to the will of the state. China is rolling out a "Social Credit" based upon social media records of its citizens that will quantify a person's 'goodness' with real world consequences.

How citizens and governments use big data and protect privacy in future will shape how the rest of the world develops, whether towards the Chinese model, or towards one that better protects individual privacy.

Things to Consider

What non-government entities could execute this kind of oversight and control? How will consumers react to further intrusions of privacy? What are the implications for balancing big data usefulness and privacy in healthcare?

23. Turn Back to One Another: Rising Value of Care Work

Automation and an aging population create an opportunity for people to return literally to caring for one another rather than striving for economic gain.

Topic Area:	Social Contracts, Healthcare systems
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Aging population; rising childcare costs; automation of the workplace
Dynamics of Change:	Return to older social primate dynamics and community structures

Capitalism has shaped U.S. society to focus on earning money as the primary activity. Care for family members is a secondary responsibility that is sometimes outsourced to a professional care giver or facility. The next ten years will see the population continue to age, placing a greater care pressure on society. At the same time automation will replace between 20% to 40% of jobs. A significant debate exists on what the impact of automation will be: Will it increase economic productivity or not? Will it dramatically increase unemployment everywhere, or simply hit some areas? Will it transform the working world and change industries? How will it affect work-life balance? Regardless of how everything else plays out, the only sector analysts expect to increase in human employment is the care and medical sector.

Increased unemployment will inevitably be part of this transition, leading to reduced household income. This will force families to care for their own loved ones, share accommodation, share childcare, look after elderly relatives, and help each other, rather than outsourcing these duties. Large-scale unemployment and the changing nature of the workplace could prompt a change in the focus of society back to family and community. Rather than life goals and aspirations focusing on making money and achieving a successful career, people could focus on each other, their families, and their neighborhoods, aspiring to create happy communities while machines generate economic growth.

Things to Consider

Could such a system be supported economically? Would this have an impact on birthrates?

What would be other dynamics of a society focused on care for each other? How might this fit with emerging interest in universal basic income or Medicare for all proposals? What would be the impact on mental health and stress?

24. Climate Migrants and Adaptation

Impacts of climate change and adaptation driving population migration and worsening inequality.

Topic Area:	Equity, Climate Change
Zone:	Innovation Zone
Strength:	Strengthening
Upstream TEI:	Climate change threats to food security, water supplies; migration; adaptation
Dynamics of Change:	Environmental challenges stimulating an adaptive response

Climate change—particularly in the form of sea level rise, uninhabitable temperatures, and extreme weather events—could create a surge of migration from the U.S. southern and coastal areas to the north and inland. Those without means to relocate would be in critical need of large-scale government aid and intervention. Those who can afford to relocate would gentrify communities, further displacing low- and middle-income families. Northern cities like Duluth, Minnesota and Buffalo, New York are anticipating climate migrants and beginning to market themselves accordingly. Other cities should begin to plan for an influx of people, targeting issues like housing, transit, food rationing, and water supplies.

As the impacts of climate change start to emerge, further adaptation and innovation as well as government policies and planning will need to be implemented to prevent negative impacts such as heightened inequality, and to enable continued stability.

Things to Consider

How will target cities' medical infrastructure respond to a flood of new citizens in need of medical care? How might food rationing take effect? How will water supplies be both protected and shared with everyone in need? How will private ownership of land change as less land is habitable? How can innovative urban planning get ahead of the oncoming flood and be proactive rather than reactive?

25. A U.S. Authoritarian State

Erosion of the U.S. liberal democratic system could create a less free society.

Topic Area:	Social Contract
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Growing global populism; President Trump; crackdowns on journalists; post truth; fake news; deep fakes; increased surveillance; smart cities
Dynamics of Change:	Political shifts towards more authoritarianism as seen in Turkey, Iran, China and in many European countries before the world wars

Voter participation in the U.S. has fallen in recent years, as polarization and growing economic inequality has amplified the perception of disconnected political elites. Continually increasing costs of living that further reduce people's living standards could erode voter participation further. Without a healthy electorate, marginal political movements can gain traction counter to majority views. There are concerns that the current administration has already begun steering the U.S. into authoritarianism: questioning protesters' loyalty; challenging the free press; proposing violent solutions to domestic disagreements; and promoting prejudice in the Supreme Court. The increasing extremity of political views challenges both sides of the political divide, and this could result in policies that seek to control the media, to limit free speech, and to authorize force against opposition groups and factions.

This rise in authoritarian governance may not always appear negative to the populace. The erosion of those democratic principles and institutions established within the U.S. government to limit ruling power and protect freedoms could alter the democratic landscape significantly. Such alterations would make possible the unchecked operation of authoritarian influence within the U.S. History has witnessed similar shifts before, and even today it is visible in world powers such as Israel, Brazil, China, Russia, and Turkey.

Things to Consider

Is there the political will to stem this tide? Has society crossed a point of no return to restore a more democratic system? Can organized special interest groups compete for political power with private business?

26. Digital Countries

Communities, countries, and cultures no longer defined by geographical borders.

Topic Area:	Social Contract
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Loss of privacy; online learning; crowd funding; social media; bitcoin; *Occupy*; growing social conscience
Dynamics of Change:	Digitization polarizing populace, creating new, like minded communities, globalization

Culture is created by common experience. Communities were traditionally geographically defined, but with technological advancement, communities could extend beyond merely physical borders. With increased digitization and more activities and services moving into the online space, more people are joining and identifying with communities of interest online. Technological advancements are enabling remote working and virtual teams and networks; online learning is stretching university campuses; and friends, coworkers, and significant others can live thousands of miles away but feel closer than ever.

As technologies like cryptocurrencies and blockchain erode traditional mechanisms of governance, these on-line communities could challenge the traditional roles of nation-states. In future, a census might use IP addresses instead of physical residences to track and group citizens and communities. Virtual residences could also affect voting and representation systems where traditional geographical caucuses could be replaced with systems allowing representation based upon online interest groups. This could facilitate a more direct democracy. AI may sort citizens' political stances and beliefs. Traditional methods of reaching physical communities, such as door-to-door campaigns and billboards, would lose effectiveness and campaigning would shift online.

Things to Consider

What could new communities mean for international relations? How would online, scattered communities be governed? What would healthcare provision and taxation look like in such a society?

27. Death of Pricing

Dynamic pricing sets the value for goods based on factors like location, demand, scarcity, interest and need.

Topic Area:	Equity, Social Contracts
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Big Data analytics, AI, IoT, Techno-holistic healthcare,
Dynamics of Change:	System adaptation to stress and innovation

AI and big data analytics will enable a new kind of truly dynamic, personalized pricing where prices will adapt in line with consumer behavior. While dynamic pricing can help reduce food waste in grocery stores and help to regulate stock. It is likely models will evolve that will seek to get the consumer to pay the most they are willing to pay for a product. This model could significantly impact the low-income and mobility-limited making them pay more for basic, necessary products than economically stable consumers in less need of medication or food. Consumers care about the "fairness" of pricing, so this system may create discontent as well as disadvantaging the poor.

As pricing feels more and more subjective and based on companies' whims, consumers might turn back to traditional modes of exchange like trading and bartering. Growing possibilities in the digital economy to exchange services for products and other services could open the market for other ways of living and relating to each other.

Things to Consider

Could dynamic pricing for prescription drugs and medical care, make medicine more accessible for lower income people? Could this lead to restaurants and grocery stores offering food in exchange for other forms of payment such as labor? How might this impact health insurance structures?

28. End of Abortion Rights

When abortion is no longer an option, women must rely on birth control, luck, and back-alley medical services; eroding rights put them in dangerous positions.

Topic Area:	Equity, Social Contracts
Zone:	Innovation Zone
Strength:	Maturing Development
Upstream TEI:	Racial inequality in healthcare, male birth control, climate crisis, growing childcare costs, birthstrike
Dynamics of Change:	Value shifts driving political and legal shifts – and the reverse

Hardening laws criminalizing abortion could lead to a federal ban. Pro-life and traditional values in much of the U.S. already lead to parents pushing children into marriage to avoid a birth out of wedlock even in the case of rape. Criminalization of abortion in El Salvador has seen women prosecuted for miscarriages and still births. No birth control method is safe and effective for every woman. Access to birth control depends on secure income and is affected by government and insurance company policies, particularly for lower-income people. Forced to carry unwanted pregnancies to term, women could face health risks, severe economic hardship, and lost opportunities. Child marriage rates could increase as could the number of women in abusive relationships. With even miscarriages being criminalized, women could be less likely to risk conception, which would impact family structures.

As the only developed country with an increasing maternal mortality rate, the U.S. already has a maternal health problem. Removing women's reproductive rights without free and easy access to contraception and reproductive health care could escalate this to a crisis. Without reproductive rights the inequality gap between the sexes would dramatically increase with detrimental impacts for women across the U.S., particularly impacting low-income communities. Over half of annual pregnancies are currently covered by employer-sponsored health insurance, putting employers in a key role to advocate for better reproductive care, starting with their employees and attempting to reverse this trend.

Things to Consider

What might the impact of climate migrants in states be without access to abortion? Could society see reproductive rights migrants in conjunction with climate crisis migrants? How might systems prepare for this?

29. End of Meat in Global Food Supply

The evolution of sustainable global food supply chains away from meat production improve health and well-being for low-income communities globally and improve resilience.

Topic Area:	Equity
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Climate change, population growth, impossible burger, growing sense of environmental and social responsibility
Dynamics of Change:	Value shifts driving political and legal shifts – and the reverse

Today only 55% of crops grown feed people directly; the rest are grown for animal feed, for meat production, and for biofuels, requiring land and water that could be used to feed people. Population growth will add one billion more people to the world by 2050, creating more pressure on global agriculture to meet demand. Meat farming contributes between 15-20% of global greenhouse gas emissions annually to which agricultural deforestation adds a further 20%. Increasing global meat production to feed the additional population by 2050 could have devastating impacts. Consumers are increasingly choosing food responsibly, and sustainably grown plant-based products are becoming more popular. Plant-based "meat" production techniques are advancing, and the *vegan sausage roll* and *Impossible Burger* are proving hugely successful. Advances in producing 3D-printed and lab grown meat make it ever more likely they could become part of daily meals.

If the shift towards a non-meat diet continues it could revolutionize global food chains. Dramatically reducing or completely ending meat production would free up huge volumes of crops for human use that farmers currently grow to feed animals. This would significantly improve food availability, particularly in developing countries where food security is poor. Cheaper, more readily available food would lower global food prices, making more nutritious diets available to poor communities both within the U.S. and globally. The increased scale of plant farming would make supply chains more resilient to the climate crisis. Further, a decrease in the use of animal fat in food production would lower levels of saturated fat in cheap, mass-produced food, making it healthier. A population level shift to a plant-based diet would not only support food security but improve the quality of food and so people's overall health. Such a shift could improve health and well-being equity across communities in the U.S. and globally.

Things to Consider

What would the impact of a healthier, cheaper diet mean for health and well-being in the U.S.? How could this relieve pressure on people who have low-incomes? What would the implications be for health and well-being and/or global trade?

30. Disparity of Climate Crisis Impacts on Food

Climate crisis stress on food supply chains disproportionately affects the poorest and most vulnerable.

Topic Area:	Inequality
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Climate change increasing drought and reducing yield; population growth; rising inequality; worsening chronic health; rising prices
Dynamics of Change:	Environmental stimulus leading to economic and social response

Food prices dramatically increased across Europe due to mounting pressure on global food supply chains after the 2008 financial crisis, a drought in Russia, piracy in the Gulf of Aden and rising oil prices. The rising prices hit the poorest in society hardest, forcing many into greater food poverty.

Food poverty in the U.S. currently affects some 40 million people, including 12 million children, from the lowest-income households in the country. As the climate crisis and population growth put more pressure on food supply chains, food poverty could spread to become the norm in the U.S. Unhealthy, cheaply made, processed food already causes disproportionate levels of chronic diseases, such as type 2 diabetes, obesity, and heart disease. As food prices rise healthy food will become even less affordable and out of reach for low-income families. This will be further compounded by increased automation, increases unemployment and lowers wages.

Food insecurity significantly contributes to inequality in that those who experience it also experience increased maternal and infant mortality and childhood malnutrition, the impacts of which can extend across lifespans. For example, hungry children are likely to perform worse at school, thus putting at risk future career opportunities. Widespread food poverty could transform the U.S. by exacerbating and expanding groups that are or have historically been and are currently marginalized.

Things to Consider

What can be done to prevent disruption to U.S. food supply chains and prevent rising costs? How could communities prevent food poverty or food supply chain crises?

31. Data Sovereignty

People may soon exercise stricter control over the circulation and use of their own personal health information.

Topic Area:	Technology
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Continued politicization of data privacy; continued privacy breaches across multiple sectors including health, banking, and hospitality
Dynamics of Change:	Growing distrust of big tech's right to collect and maintain user data paired with recent antitrust reviews pertaining to data privacy

Intersecting developments in digital technologies are increasingly challenging notions of privacy. Rising public concern about the present handling of data breaches and digital privacy could result in a form of sole proprietorship over people's own health information. People are increasingly interested in improving accessibility and transparency regarding how third parties use personal information. This may create new opportunities for individuals to participate directly in the transfer and withdrawal of their own medical information between healthcare providers. Similarly, a sole proprietorship model in which individuals control the movement of their health data could also drive significant changes to medical billing and insurance by means of increased transparency surrounding the billing process. Ownership and sovereignty of personal data could empower consumers to really participate in data analytic programs for medical research and healthcare delivery.

Examples might include new forms of digital fingerprinting and consent. An improved system could specify that individuals must personally approve the sharing of their health information as a part of the referral process between primary care doctors and specialists. Another approach might be a kind of two-factor-authorization in which individuals are directly notified when healthcare providers attempt to access their health information.

Things to Consider

Might data sovereignty lead to a complete revamp or elimination of the social security number?

How will increased personal control over one's health information affect consumer choice with regard to healthcare options? What could data sovereignty mean for the provision and effectiveness of healthcare systems?

32. *Radical Transparency*

Opening up the data about everything to everyone.

Topic Area:	Healthcare System, Equity, Technology
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	The U.S.'s Changing Cultural Values; Runaway Healthcare Spending; Medical/Health Innovation is Accelerating; Healthcare Becoming Increasingly Digital and Distributed
Dynamics of Change:	Social backlash and value shift driving change and innovation.

'Radical transparency' is emerging as an extreme version of the open-source trend. It promotes airing and sharing of all details of decisions, designs, processes, and products – both the strengths and the weaknesses – as a means to understand and critique their underlying assumptions. In terms of business and government, this means revealing exactly what goes into goods and services, and how they function; it means, for example, publicly sharing detailed cost breakdowns and price lists. Research indicates that transparency both increases effective performance and generates consumer trust – and can rebuild damaged trust. Companies like Athena Health are pushing the evolution of 'accountable care organizations,' mining Medicare cost data to compare what different providers charge for the same service. Combined with easily transferrable electronic medical records, such radical transparency on health services and their costs would allow patients to switch providers to maximize their value for money.

Software advances like blockchain platforms – Almond is one example – are increasingly designed to support efforts in radical transparency across businesses, government agencies, and institutional service providers. Almond enables food customers to trace specific ingredients from their origin point to their use in a product – in hospitals, the equivalent would be for patients to track every medicine, instrument, and surgical supply used in their surgery, and all the orders and recommendations in their care charts. The stumbling block is the legacy of fragmented, disparate, disaggregated data across the healthcare system. If that can be overcome, blockchain and AI innovations could provide secure EMRs and a radically transparent health information exchange.

Things to Consider

How might radical transparency intersect with the patient's and physician's need for privacy? How could this contribute to medical research breakthroughs achieved by analyzing Big Data originating from radically transparent health systems? What biases and backlash might result from the general public being able to access complete information about the health system?

33. Ending Pain and Anxiety Through DNA

Gene therapy to treat post-operative pain, chronic pain, PTSD, wound healing, and anxiety.

Topic Area:	Healthcare
Zone:	Innovation Zone
Strength:	Intuitive Possibility
Upstream TEI:	Opioid crisis, chronic pain, growing rates of anxiety, depression, and suicide, technological advances in gene therapy
Dynamics of Change:	Advances in technology transform assumptions

Chronic pain currently costs the U.S. government around $100 billion annually in treatment and lost wages. In addition, the country is facing a crisis with significant growth in rates of anxiety, depression, and suicide. Recently scientists identified a genetic mutation in a Scottish woman who feels no pain, heals more quickly, is incredibly happy, and feels no anxiety. A genetic mutation in one of her chromosomes raises the level of a naturally occurring brain chemical. Researchers hope that this may provide lead to potential gene therapies that could prevent post-operative pain and anxiety, chronic pain, and Post-Traumatic Stress Disorder, and improve wound healing.

A simple gene therapy that addresses both chronic pain and provides a non-drug cure for anxiety, depression, and PTSD could significantly reduce risks of addiction and reduce drug use. In addition to improving overall quality of life, this could also mean more specifically that chronic conditions would no longer render patients unable to work, potentially removing one trigger of poverty.

Things to Consider

What could an end to pain mean for the healthcare system? Could such a technology end the opioid crisis? What might this mean for mental health care? Could such a therapy significantly reduce suicide rates? What might be the wider social and economic implications?

34. Zombie Viruses and Toxic threats emerging from melting permafrost

Infectious microbes, long since frozen, and reservoirs of environmental toxins emerging from melting permafrost could put populations at risk.

Topic Area:	Healthcare
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Climate change, melting permafrost, evolution of disease, environmental degradation
Dynamics of Change:	Environmental stimulus triggering social, cultural, economic, and political response

In 2016, seventy people in Siberia were hospitalized and a small boy died from an anthrax infection traced to ancient reindeer corpses emerging from the thawing permafrost. Heatwaves are becoming more frequent at higher latitudes, with temperatures 25 degrees above normal altering the landscape. Acres of toxic mercury and infectious agents buried in permafrost are being released into the environment with unpredictable effects. While many microorganisms cannot survive extreme cold, some can last for thousands of years. Spores are particularly hardy, and viruses survive well, so these could present significant risks for mammals and plants. Viruses previously thought dead, such as smallpox, Spanish flu or plague, lie dormant in bodies buried across Northern Asia, Northern Europe, and North America.

The permafrost is microbial dark matter. Researchers resurrected two never-before-seen viruses from the same 30,000-year-old deposits. Both reawakened in laboratory dishes and infected living amoebas. These zombie viruses have been tucked away in the permafrost for thousands of years, unknown. What killed Neanderthals is also unknown. Could people be at risk from diseases in thawing Neanderthal remains emerging from the melting permafrost?

The melting permafrost is a Pandora's box of disease and toxicity, having provided perfect conditions to preserve bacteria, viruses and toxic chemicals for centuries. Coupled with growing geographical ranges for diseases and the carriers such as mosquitos that spread them (for example, Dengue spread to Texas and malaria occurs at higher and higher latitudes), the permafrost could resurrect a pandemic of ancient disease. At the same time, massive mercury reservoirs could release tons of the toxic pollutant into the water table and food chain, poisoning water, fish and agriculture with devastating consequences.

Things to Consider

Would the U.S. system be able to cope with an epidemic of a previously unseen virus? Could there be implications for farming in the U.S. if spores infect crops? What might communities or governments do to prevent this potential threat?

35. *Ready Player, Escape*

The (potential) rise of escapism aided by VR, AI, AR.

Topic Area:	Technology
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Sustained development of artificial intelligence (AI), virtual reality (VR) immersive technologies, mainstreamed prioritization of self-care and emotional well-being, aging population, micro-dosing, increase in TV streaming services, growth in gaming/e-sports, rising mental health crisis, climate crisis
Dynamics of Change:	Technological innovation driving social changes

TV streaming services such as Netflix have changed the way people consume entertainment, with smart phones and tablets taking entertainment wherever people go. E-sports, watching other people play video games, and interactive social games such as *Fortnite* are now multibillion-dollar industries. As VR, AR, and AI technologies improve, our experiences will become increasingly immersive. Anxiety and depression rates are rising, and the future looks bleak with the prospect of growing unemployment from automation and the climate crisis. People are already increasingly turning to media for escapism. This trend amplified by more immersive media could create a community of people opting to live more in the virtual world than the real world.

These new technologies could provide avenues for assisting people with mobility limitations experience a different life, interacting with others through immersive technology. Immersive online worlds could enable people to live outside of the physical concerns of reality but could also reduce social interactions and connections with the people around us.

Things to Consider

In what ways could using AR/VR in healthcare change service delivery? How should the technology and healthcare industries collaborate in future to test the health benefits and risks of AI and VR? What could the implications be of a world where more and more people escape to an immersive, virtual world?

36. Techno-hubris in Health

Traditional scientific oversight slows technological development and changes to health systems.

Topic Area:	Technology
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Broad acceptance of the role of business in innovation; growing concern over unproven medical treatments and health-related tech; Techno-holistic Healthcare; personalized medicine
Dynamics of Change:	Dialectic swing – over-investment in one kind of change generates backlash

Entrepreneurial ventures in the past decade have prompted pundits to coin the term "stealth research" to describe "biomedical innovation happening outside of peer-reviewed literature." Recent research tracking healthcare start-ups with valuations over $1Bn noted multiple examples with "limited or non-existent participation in publicly available scientific literature." The exemplar case of fraudulent health technology entrepreneurialism is, of course, the exposure of medical start-up *Theranos* in the 2015 scandal that resulted in closure of company in 2019. Looking at more popular consumer products and services, the unproven treatments and products promoted at Gwyneth Paltrow's *Goop* summit also generated negative publicity and questioning of the wellness industry.

Digital platforms and technologies have outpaced regulatory regimes and enabled the widespread sales of unproven medical devices and technologies. Regulatory guidelines pertaining to health-related technologies need to be updated. It is likely the proliferation and usefulness that could be presented by technological innovation in healthcare could be slowed by this techno-hubris outrage.

Things to Consider

What types of policy changes could enable innovation and uptake of healthcare technologies while protecting consumers? In what ways should health professionals be able to directly participate in the regulation and vetting of health-related start-ups? How can technology progress quickly and safely?

37. Humans Training Machines to Train Humans

Continual mechanical and AI advancement means machines will do complex, sophisticated tasks better than humans, and in turn teach humans better ways to perform those tasks and access knowledge.

Topic Area:	Technology
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	Virtual education and teacher training/careers, medical testing and careers, AI implants, equity and access problems
Dynamics of Change:	Technological innovation driving economic and social evolution

AI/machines are already outperforming humans in fields such as teaching and detecting cancer. As they are phased into other fields, they will continue to surpass human capabilities. Their successes will teach us new ways to do things and give us access to wider stores
of saved knowledge than humans have ever had. AI brain implants will connect these capabilities directly to the minds of those individuals who can afford them, giving them a huge advantage over people who cannot access the technology. AI/machine-based health services could address growing health care deserts in rural and economically depressed areas. Governments and NGOs could also potentially deploy such services to disaster sites more quickly and safely than deploying human responders.

These machines, providing better diagnoses than their human counterparts, could depress or eradicate long-term career opportunities for radiologists, pathologists, and other specialties. AI knowledge pools could enhance human teaching and deliver more individualized learning experiences virtually, meaning students would spend less time in classrooms. While potentially addressing teacher shortages in some communities, it could also put many teachers out of work in the interest of efficiency and saving money.

Things to Consider

If brain implants become the default, and memorization is no longer necessary, how could learning evolve? How might human activities like research, education, business, arts, and even sports address the unfair advantages of this new have/have-not gap? What could this mean for healthcare?

38. Biased Algorithms

Humans embed bias in what they build, and it can last for generations.

Topic Area:	Healthcare System, Technology
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	The U.S.'s Changing Cultural Values; The U.S. is Becoming Increasingly Diverse; Unequal Burden of Disease; Medical/Health Innovation is Accelerating; Healthcare Becoming Increasingly Digital and Distributed
Dynamics of Change:	Increased proliferation of collected health data from various daily devices

Pharmaceuticals and medical protocols already suffer from in-built biases arising from medical trials too-often specific to young white men. Machine-learning algorithms and artificial intelligence software might make these biases worse rather than eliminate them. As the algorithms 'learn' by analyzing historical data, they can be led astray when that data reflects historical bias against vulnerable and marginalized populations. This in turn can lead to skewed and inappropriate recommendations. For example, researchers who rely on current publicly-available genomic data to study disease will be basing their conclusions on data from participants 81% of whom are European in descent. Without analysis of variations across populations, it is impossible to determine what impact those variations might have on treatment.

Medical researchers are working to address these issues of analytic bias, in a proactive effort to use machine learning to improve equity. This means addressing three different sources of bias: First, data itself may be more fragmented and incomplete for some populations and reflect in-built biases in assumptions about what is normal. Second, the actual algorithms are built on assumptions, and where researchers fail to critique those assumptions thoroughly, they can replicate bias. This is worsened when research objectives are not aligned with the need to avoid discrimination. Third, researchers may neglect to monitor and evaluate the outcomes of applying algorithms to patients and treatments. Ensuring equitable outcomes means constant questioning and dismantling of assumptions, robust evaluation of outcomes, and including of patients of color, Native American, women and other medically marginalized patients in research design.

Good design is critical in making the most of the potential these analytic innovations promise. More and more healthcare institutions, hospitals, and clinics are betting that these Big Data / AI systems are the future of effective, value-for-money healthcare. Start-ups using AI for healthcare are attracting billions in venture capital. For any of this to be useful, these systems must be audited for bias – and the more serious the consequences of potential bias, the higher the standard should be.

Things to Consider

Can bias ever be truly eradicated in any system originating in human judgment? What could be the ethical and legal implications of embedded bias in a future where algorithms and AIs might be providing medical services directly?

39. A Changing Understanding of and Response to Racism

Topic Area:	Equity
Zone:	Innovation Zone
Strength:	Strengthening Signal
Upstream TEI:	The U.S.'s changing cultural values; the U.S.is becoming increasingly diverse; unequal burden of disease
Dynamics of Change:	Antiracist movement; Ibram X. Kendi-Antiracism Center, American University

The impact of racism is evident in every aspect of society, with resulting inequities for indigenous peoples and people of color. Outcomes of a U.S. racist society is evidenced in many forms including, voter suppression, wealth gaps, health disparities, mass incarceration, deportation, unequal access to quality education, food deserts, and redlining, just to name a few. We have historically described racism as about people and their beliefs and behaviors--one was either racist or not racist. However, regardless of anyone's racist ideology, we have in the U.S. an entire schema in which racism is baked into structures, policies, and practices that consistently produce inequities and disadvantage people who are not white. This will continue to be true even if racist ideas and ideology completely disappear.

Antiracism seeks to proactively dissect and rework the policies and practices in every aspect of society to overhaul system-embedded racist policies. If successful, it has potential to have profound impact on health and well-being because if shifts the focus to meaningful policy and practice change that can produce equitable outcomes. Used in this way, antiracism is an emerging issue and concept that could have profound influence on society's ability to achieve equity.

Things to Consider

What would it take to dissect and rework governmental and organizational policies throughout the U.S. to mine for and remove root cause policies and practices that continue racism and produce inequities today? Who and what would need to be involved? What are the potential outcomes if such an effort was successfully implemented?

Foresight Zone

40. Extreme Longevity for the Few

A confluence of medical advances give rise to longevity treatments that vastly extend lifespans for those able to afford them. A new global elite of ultra-long-lived, ultra-healthy people emerges.

Topic Area:	Equity, demographic shifts
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Accelerating medical innovation; widening wealth gap; increasing cost of medications; personalized medicine
Dynamics of Change:	Exponential improvement rates in several medical technologies (DNA sequencing, neural imaging); technology diffusion patterns—first adopters have tremendous benefits

The quest to "cure" aging has long resided on the fringes of medical science, but that is rapidly changing. Advances in genetics and biotechnology are suggesting new ways of undoing the damages of aging. More and more anti-aging biotech companies are receiving funding from big-name donors (e.g. Jeff Bezos and Peter Theil) and big-name companies like *Google* (*Calico*) are also getting in on the act. Research into negligible senescence and regenerative medicine is accelerating. The notion of extreme longevity treatments—medical interventions allowing recipients to live healthy lifespans of 150 to 200+ years—is no longer purely in the realm of science fiction: it is an emerging issue with significant implications that society will need to address.

Given the likely complexity of the medical interventions required, extreme longevity treatments will probably be prohibitively expensive (and not covered by insurance) at first, and very limited in quantity. As a result, only people with great wealth will have access. This will not only blow open today's already widening wealth gap but could also result in qualitatively different strata of people. In time, widespread access to extreme longevity treatments could pose its own complications: from additional population growth (fewer people dying) to having to completely rethink retirement and social security systems.

Things to Consider

How can society ensure equitable access to medical enhancement technologies (from life extension to designer babies)? Will FDA and other regulators recognize aging as a treatable condition (for drug trials)? What will be the societal pushback on this assault on mortality?

41. "Everywhere" Living Online

A new sort of social media creates an online world which changes traditional prejudice and mindsets, reshaping society.

Topic Area:	Equity/ social contracts
Zone:	Foresight Zone
Strength:	Intuitive possibility
Upstream TEI:	Social media particularly *Fortnite* gaining popularity; more products and services moving online; IoT
Dynamics of Change:	The lived experience theories of Frantz Fanon

For years science fiction writers and futurists have predicted a computer-based virtual world that will change our society. Today, society is closer than it has ever been to making that a reality. Social media started as a fad and yet has completely reshaped today's society, creating polarization, fake news and even influencing the outcome of elections.

The game *Fortnite* is now demonstrating a new kind of social media. This interactive social space offers a place where people can hang out and develop friendships through shared experiences, as opposed to traditional platforms where users scroll in isolation. In 2018, ten million users logged into the game to experience a short live music concert; and *Weezer* launched their new album through the game. Pundits are now viewing *Fortnite* as the mainstream successor to *Second Life*, the 2003 immersive computer experience once heralded as capable of social transformation. Second Life never gained traction outside of the gaming community. In contrast, *Fortnite's* popularity outside the gaming community has grown more quickly than any previous game.

Fortnite's success in leveraging the norms of social media and computers integrated into people's everyday lives suggest the beginning of a transformative change. Computer developers are now working on new platforms similar to *Fortnite:* immersive, fun, social, gaming experiences connected to daily life that will provide more revenue-gathering opportunities, encouraging users to spend even more time in the game. Teens and tweens are *Fortnite's* main audience, many of whom spend on average ten hours a week on the platform. In the *Fortnite* online world, sex, race, class, looks, wealth, disabilities, and privilege do not exist. People interact with a shared goal and relationships are formed in a space free from external prejudice. Increased time in the game during teenage development years could significantly reduce prejudice and inequality in society. Ready, Player One?

Things to Consider

What could the health implications be for a society spending more than ten hours a week in a virtual world? How might such a world affect society? What would some of the risks be?

42. Machine Charities

Smart technologies give rise to 'machine charities' where networks of AI-powered devices generate money and make donations to the most effective charities or even make direct microloans.

Topic Area:	Technology
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Internet of things; blockchain; cryptocurrency; AI personal assistants
Dynamics of Change:	Technological innovations create opportunities for new paradigms that transform systems, overturning traditional assumptions

A new form of philanthropy is rising from the confluence of smart grids, secure and transparent cryptocurrency, ubiquitous computing, and ever-more capable AI: 'Machine Charities'. These are networks of smart devices that sell excess capacity (electricity, processor cycles, etc.) to generate funds, and then AI financial programs donate those funds via smart contracts—autonomous contracts that ensure performance requirements are met—to those charities proven most effective by big data analysis. Machine Charities, as they grow more sophisticated, could even bypass traditional avenues to make individual, grassroot-level micro-donations or loans.

The root technologies enabling Machine Charities, like blockchain-powered cryptocurrencies, could ensure fully transparent transactions. Coupled with AI analysis of big data pools, these technologies could provide rapid-response funding when disasters strike. As smart networks spread around the world, machine charities could come to dominate the philanthropic realm, with millions of contributing devices part of a single charity. At the same time, their emphasis on transparency and their reliance on AI could mean that people trust such charities to handle global problems more than they trust traditional, human-driven philanthropy.

Things to Consider

How can people ensure the algorithms controlling machine charities are unbiased? How will 'the greatest good' be determined when it comes to automated donating? When a machine charity network of devices crosses multiple countries, who controls/regulates the network?

43. World without Money

Evolution of a new economy functioning beyond traditional finance.

Topic Area:	Social Contracts
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Sharing economy; growing activism for sustainability; growing dissatisfaction with inequality; growing concern on climate change
Dynamics of Change:	Climate crisis activism, socialist revolutions, welfare state, British Blitz Spirit

The 2008 global financial crisis, subsequent austerity measures, growing inequality, and awareness of inequality kicked off social movements demonstrating an increase in anti-capitalist sentiments. Since then the looming impacts of issues such as the climate crisis, fast fashion, growing poverty, and inequality have spurred the collective social conscience, particularly for younger generations. While these critical economic values were emerging, the sharing economy evolved through apps such as *Airbnb, Uber, WAG* and *Turo*. Although these platforms still operate on a capitalist, profit-based model, they have encouraged greater interaction between people and encouraged a more open attitude to sharing. People's interest in, and exploration of, the gifting and trading economies has also increased. The growing popularity of the *Burning Man Festival* highlights this, as does the replication of this model in the mass climate protest *Extinction Rebellion* movement.

If such sentiments continue to grow, communities around the world could adapt and evolve away from a capitalist market based on profit to one based the commons, gifting and exchange. In this new exchange economy, citizens could share what they can, when they can, in exchange for other needs and services. The commons sharing economy existed before capitalism and comes out of shared values and a sense of community. As values shift and social conscience grows, such an economic system could increase in popularity and potentially evolve beyond traditional capitalism. Crowdfunding could facilitate a distributed version where gifting and sharing could spread across geographical boundaries as well as within the immediate community.

Things to Consider

What could the impact of such an economic shift be for the private healthcare system? Could this lead to legislation changing to open up free healthcare? What other impacts could this have on society? How could this tie in with automation?

44. Living Medicine

Living pills of genetically engineered or even synthetic bacteria are used to deliver medicine precisely, to alter the microbiome, to perform immunotherapy, and even to cure antibiotic resistant infections.

Topic Area:	Technology, Healthcare systems
Zone:	Foresight Zone
Strength:	Strengthening Signal
Upstream TEI:	Personalized medicine; genetic modification; rapid/cheap DNA sequencing; synthetic biology
Dynamics of Change:	Disruptive innovation and amplifying evolutionary change

The ability to alter a person's microbiome by introducing outside microbes is garnering increasing attention. Recent discoveries suggest that the microbiome plays a major role not only in gut health but also in mental and brain health (particularly in depression and autism, and potentially in Parkinson's and Alzheimer's). Genetically modified bacteria are already being used in the lab to produce therapeutic compounds like insulin, and clinical trials are beginning for microbial oral vaccine delivery as well as for fecal transplants to fight the superbug C. difficile.

In the future, "living pills" containing modified microbes tailored to the specific patient will be used to deliver medicine more precisely, to perform immunotherapy, to alter a person's microbiome, to enhance brain health, and to cure disease (viral bacteriophages to combat resistant infections). Our microbiomes are directly affected by how people live their lives, from the food they eat to the amount of stress they experience. Taking a "living pill" could potentially correct many of the negative health effects of poor living.

Things to Consider

Will the introduction of GMOs into people's bodies prompt a similar pushback against GMOs in food? How could this change the face of medicine? What could be the wider implications?

45. Demographic Assumptions Overturned

Challenges to 'population bomb' narratives imply a future of fewer people crammed into smaller viable environments, as climate breakdown forces large-scale migrations to remaining viable temperate zones.

Topic Area:	Demographic Shifts
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Educating women; global digital access; African urbanization; antibiotic resistance; climate breakdown
Dynamics of Change:	Environmental challenges and contextual shifts disrupt traditional structures

Bricker and Ibbitson document a rising challenge to long-entrenched demography dogma, the ongoing 'population bomb'. "In roughly three decades, the global population will begin to decline," they write. "Once that decline begins, it will never end." Watershed changes are affecting values and worldviews and women's childbearing aspirations; "external forces that used to dictate people having bigger families are disappearing everywhere."

In developing economies, more and more women are educated and digitally connected, and much of Africa is urbanizing at twice the global average. In developed economies, childlessness has been rising for decades. That may accelerate as more women considering our uncertain future are declining to have children at all - "apocalypse is part of their family planning."

Increased lifespan is another assumption of the population bomb narrative that may be eroded by increases in ambient insults to health such as pervasive contamination of air, water, and the food chain; antibiotic-resistant microbes; and climate challenges to human health such as impacts of heat stress on the immune system. With the melting of the Himalayan glaciers, the world's largest population – much of India, Nepal, and China – will face diminishing water supplies. By mid-century these conditions may drive millions to the remaining temperate zones, cramming global population into reduced viable space.

Things to Consider

What new reproductive health issues might arise if this trend strengthens? What might be emerging health challenges, or opportunities, of decreased populations?

What epidemiological impacts might arise from diverse populations crammed into smaller viable land space?

46. Co-ops at the end of Capitalism

Inequality, automation and rising communalism create an economy based on shared ownership beyond capitalism.

Topic Area:	Equality, Social Contracts
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Automation; Universal Basic Income; growing inequality; climate change; crowdfunding; the sharing economy
Dynamics of Change:	Technological innovation enables an innovative re-inscribing of an old model

Wealth inequality has reached new heights in 2019, with 26 of the world's richest people owning as much as 50% of total global finances. Automation is expected to increase unemployment by as much as 40% in the next twenty years and this will only worsen inequality. Increasing inequality in society is attracting concern, illustrated by movements such as *Black Lives Matter* and *#MeToo* that draw attention to widening divisions across society. In response, the sharing economy is also growing, with people increasingly using internet platforms to rent and contract services from each other "directly." Currently, these apps still operate on a capitalist model, making the host far more profit than the people advertising or purchasing through them. With continued use, however, people are becoming accustomed to interacting with each other rather than with a service provider. Movements such as *Occupy* and *Extinction Rebellion* are bringing people together and highlighting a growing disgust at the exploitation, inequality and lack of social justice in global capitalism.

Activists are searching for a different economic model. One growing in popularity is the cooperative, where members come together to spread risk and share capital in order to have ownership of their business interests. Cooperatives have been around for centuries, but what is new is the motivation to form cooperatives intentionally, both to challenge big corporations and to operate more sustainably. The composition of communities working together in co-operatives is also changing. Technology now enables global collaboration, where people from different continents and societies can invest in each other, working together along lines of shared interest and belief rather than mere geographical proximity and lack of alternatives. If this movement gains traction, it could change the global capitalist order into something smaller and more equal based on community rather than on profit and exploitation. Something global, but local, ecologically and economically sustainable.

Things to Consider

What would this mean for investments? What could the impact be on equality? Could climate activism help create such a world? Would the global economy ever move beyond capitalism?

47. Redefining Childbearing

Exo-wombs could change traditional structures and presumptions around childbearing

Topic Area:	Equity, social contracts
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	IVF, growing anti-abortion legislation, diversification of the definition of family, increasing gender equality
Dynamics of Change:	Technological innovations shaping society

Technology leading to the mainstream use of artificial wombs, or exo-wombs, is steadily advancing.

The psychological, social and economic impacts of a working artificial womb could be profound. The womb is essential for gestation, but an artificial womb could dramatically alter people's assumptions about childbearing. Human childbirth is risky - about 830 women a day still die from childbirth or related causes. If women are no longer required for childbearing, their roles and responsibilities of raising children could change as well.

In a world where the physical burden of childbearing no longer rests unequally upon women, pregnancy would no longer have health or career implications for women, and they would not risk death in childbirth. Child rearing responsibilities could begin with daily care and monitoring of the exo-womb, setting expectations and habits of childcare responsibilities shared equally between partners. This in turn could contribute to true gender equality in the home and workplace. As childbearing risks would no longer increase with age, couples could opt to start families much later in their lives and careers, when they had achieved financial stability. In addition, basic reproductive rights could more easily parallel universal gender rights, with the childbearing process for same-sex couples identical to that for mixed-sex couples.

As with any sophisticated new technology, exo-wombs would most likely begin as a luxury option available primarily to the wealthy. Over time, as with other innovations, costs would drop. If widely used, exowombs could dramatically level the playing field for gender and sex equality in the U.S. Furthermore, as women of color, especially African American women, face higher risks of child and maternal mortality, this transformation in childbearing could reduce those risks substantially.

Things to Consider

What impact would the end of maternity services have on the health system? How would ex-wombs be initially received? Would there be a religious backlash?

48. Zoonotic Outbreaks the 'New Normal'

Zoonotic infections become more frequent, severe and widespread as more human populations displaced by the climate crisis are exposed to different species.

Topic Area:	Technology
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Habitat loss; urbanization; rising incomes and changing dietary habits; climate refugees and migration; environmental shifts; antimicrobial resistance
Dynamics of Change:	Changes in the natural world and changes in the human world combine to produce a virtuous cycle of increasing disease

Zoonotic diseases—diseases that make the jump from animals to humans—are emerging at an increasing rate around the world as humans encroach more and more into 'wild' areas. Zoonotic diseases arise when humans and animals inhabit the same local environment, especially when humans eat those animals or are exposed to their droppings. Such diseases can come from both domestic and wild animals and have always existed, for example Ebola from bats, avian and swine flu from birds/pigs, and toxoplasmosis from cats.

Soon the growing impacts of global economic development and over-consumption will amplify the accelerating climate and environmental crises. This suggests that zoonotic outbreaks could become much more common and severe in the future as populations mix with more animal species. Climatic change drives animals to alter their natural ranges, weather-related disasters, food and water availability, habitat loss and rising sea levels will drive human and animal populations to relocate. With reduced habitable land more animals will move into urban areas while stressed food supplies will increase demand for bushmeat and traditional animal-based medicines. Growing populations and food demand could lead to exploding populations of farm animals in the developing world.

Researchers are monitoring the emergence of novel zoonotic diseases by deploying new surveillance programs, including social media monitoring and mapping wildlife movements. Experts are pessimistic, suggesting that the world remains unprepared for a future of more zoonotics: most experts point to a zoonotic infection from wildlife as the most likely candidate for the next global pandemic.

Things to Consider

Will increased disease outbreaks force people to reconsider settlement patterns? Will wider acceptance of meat-substitutes and lab-grown meat actually reduce demand for meat and therefore reduce farm animal populations?

49. Runaway Microbial Tribbles

Synthetic microbes introduced into the environment for bioremediation purposes could prove too successful and escape control with significant consequences.

Topic Area:	Technology
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Bioremediation; rapid/cheap DNA sequencing; synthetic biology; living medicine;
Dynamics of Change:	Technological evolution driving change

Naturally occurring microbes able to digest plastic and other modern waste products have already been successfully used in bioremediation efforts. Synthetic biology could allow the creation of much more efficient microorganisms able to tackle a wide array of waste substances. The goal: synthetic organisms able to eliminate human-made contaminants in ecosystems around the world. The nightmare: synthetic microbes that get out of control in the general environment, eat entire ecosystems, the food supply or plastic items that are still very much in use, and potentially even pass 'synthetic genes' to natural organisms. Introducing a new organism into an existing ecosystem always carries risk. scientists could engineer safeguards into synthetic organisms to prevent these nightmare scenarios. Such as "genetic firewalls," using non-natural DNA bases or amino acids that are incompatible with natural life. Other specialized cellular mechanisms could also potentially control survivability and reproduction.

Carefully crafted synthetic micro-organisms with built-in safeguards are likely to become invaluable tools in environmental restoration. The increasing availability and decreasing cost of synthetic biology design tools increases the risk that a local, do-it-yourself effort could produce an extremely potent organism *without* safeguards. In 2016, for example, a team of high school students genetically modified a natural bacterium to break down plastic with the hope of one day introducing the bacteria into Baltimore Harbor.

Things to Consider

What safeguards can be put in place around the development and deployment of synthetic organisms without preventing innovation? How might the U.S. public react to the introduction of synthetic organisms into the environment? How might a synthetic organism be controlled once out in the environment?

50. Kids Curing Kids

Advances in synthetic biology enables kids to develop DIY cures to help their peers.

Topic Area:	Technology
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Personalized medicine; genetic modification; rapid/cheap DNA sequencing; synthetic biology
Dynamics of Change:	Dialectic—the combination of biotechnology and generational hardship leads to a new avenue of mental health treatment

Advances in DIY synthetic biology will enable just about anyone to design and produce their own biologic and genetic treatments. Children are already being taught to code, in time, they will be able to create personalized treatments using DIY biolabs by accessing ever cheaper biotech tools: DNA sequencing, a rapidly expanding library of online biohacking tutorials, and burgeoning biohacker communities, both online and offline.

These biosynthetics might more effectively treat depression via tailored therapeutics, or as an escape via designer hallucinogens. Kids may seek to cure their families and peers, while others might seek to enhance their academic or workplace performance through nootropics. Some may even hack their genetics to improve themselves or perhaps to edit out depression, addiction, and other health challenges.

The proliferation of home biolabs and the resulting production of personalized medications and biologics, like at-home insulin, could significantly disrupt today's healthcare system. More and more patients could simply by-pass doctors, pharmacies, and hospitals, for cheap, do-it-yourself treatments. These could present serious problems through reduced oversight and safety mechanisms but could also not only drive down the costs of healthcare delivery and restructure the system.

Things to Consider

How might the law regulate such activities to safeguard from harm while not slowing innovation? How do people avoid the scenario of a disgruntled youth building a super pathogen? How might this impact health and well-being?

51. Editing Out Addiction

CRISPR could edit addictive substances out of the environment (e.g. nicotine-free tobacco plants) and even reprogram / remove addiction pathways in the brain.

Topic Area:	Technology
Zone:	Foresight Zone
Strength:	Intuitive Possibility
Upstream TEI:	Biotechnology; living medicine; kids curing kids
Dynamics of Change:	Technological disruption driving social, economic, and political change

Addiction such as to alcohol, tobacco, gambling, opiates, other drugs, and sex has significant negative personal and societal impacts. The U.S. is currently gripped by a significant opioid addiction epidemic. Biotechnology could help end addiction by potentially editing the brain to switch off the brain's addiction pathways or to alter substances to reduce addictive qualities. CRISPR, the gene-editing tool, is already providing innovative possibilities in the fight against addition. Scientists are using CRISPR to study the interactions between certain proteins and the genes responsible for addiction in the human brain. They have created CRISPR-modified mice who are resistant to cocaine addiction and immune to overdoses. While others have used CRISPR to grow tobacco plants with 99.7% less nicotine than natural plants, yielding a significantly less addictive cigarette. Similar genetic edits could alter opium poppies and the coca plant.

In the future, this two-pronged approach to addressing addiction, coupling brain hacking with environmental modification, could lead to the elimination of addiction as a human response. This would have significant impacts on health and society. Further, research suggests that obesity and many overeating related conditions are caused by natural addictions to sugar and fat so this could even cure the obesity epidemic.

Things to Consider

What might be the ramifications of eliminating addiction? How would this change society? Many addictions result from unresolved trauma, especially traumas experienced in early childhood; if addiction is edited out, what will be the human response to unresolved trauma? What are potential unforeseen impacts of such radical re-wiring of people and of nature?

Disruptive Combinations

One of the practices used to identify emerging issues is the VFS method of *disruptive combinations*, which is used to identify potential nonlinear disruptions. "Disruptive combos" are typically generated by identifying a pair of individual emerging issues, e.g. synthetic biology and automation, and then combining those to explore the "mash-ups" that would result. A disruptive combos approach is useful for exploring all categories of emerging issues, but it is particularly useful for exploring Intuitive Possibilities.

While the previous section presented an initial set of 51 emerging issues that could shape the eight topic areas relevant to health and well-being in the U.S., the following are ten disruptive combos built from those fifty emerging issues, along with some of the trends previously reviewed. Exploring how individual trends and emerging issues might interact with each other to produce surprising outcomes and impacts is a key 'next step' in using horizon scanning data. Note that each disruptive combination will carry the combined impacts and implications of each of its component changes.

1. Nomadic Hospitals / Clinics on the Go

Contributing Emerging Issues: Automated Transport Networks; Techno-Holistic Healthcare; The New Job Market

An automated transport network including high-speed autonomous travel across large land distances could revolutionize our attitude to travel, time and distance. Automated transport networks run by renewable electricity would be able to move continuously: they could become more than mere transport systems, evolving into moving real estate. This could completely alter the business model for healthcare service provision in terms of location, hours worked by healthcare professionals, and times patients might seek services and cost. Automated transport networks could provide constantly mobile clinics, doctors' offices, even operating theatres.

Connected and supported by the internet of things and big data, these purpose-built units could travel between places as doctors perform services. They could connect with other units for recovery after a procedure, or for a different service. On-the-go clinics could provide more flexible working arrangements for healthcare workers and greater access for patients as they would no longer need to travel to hospitals or doctors' offices. This could significantly improve the provision of services to current 'healthcare deserts' in some rural communities.

2. Digital Civil War

Contributing Emerging issues: Data Sovereignty; Digital Countries; "Everywhere" living online; End of Personal Privacy

Increased digitization could develop communities defined by their view of the role of data and the internet. Some people may become so connected to their online communities that they value them over traditional geographical communities and nation states. Others may be overcome by their fear of data surveillance, loss of privacy and control. These different communities would live in completely polarized worlds. Both would present significant challenges for governance as products and services move online and become increasingly connected. Those unwilling to accept a digital world could attempt to isolate themselves from digitization. Those opting to live within the online world could reject traditional governance and try to break off into new online countries. These conflicting ideologies and behaviors could create a new fracture line for conflict, as one side rejects traditional society for a digitized world and one side rejects digitization itself. Essentially these two competing ideologies would be warring over the very fabric of their realities.

3. Retreat to Otherwhere/Otherwhen

Contributing Emerging Issues: Increasingly Extreme U.S. Political Swings; Collapse of a Generation; Climate Migrants and Adaptation; Digital Countries

As the impacts of social, technological, economic, and environmental change mount, the U.S. cultural schism could continue to harden. Those fearful of change would try to clutch an (imaginary) golden past of stable communities, stable jobs, and stable family and gender roles. The adventurous would try to push novel paradigms, disruptive change, and invent systems suitable for post-normal times. Digital platforms would make it easier for scattered communities of interest to find each other and reinforce their beliefs. NIMBYism could amplify denialism beyond the merely geographical to the temporal: 'it won't (can't/shouldn't) happen here' and 'it won't happen now' could increasingly be applied to climate crisis impacts, species extinction impacts, pervasive contamination (pollution) impacts, and impacts of forced migration. Society could deal itself a mortal blow by an epidemic of denial, paralyzing its ability to address large-scale problems.

4. Shared World: End of Consumerism

Contributing Emerging Issues: It Takes a Village; Automation Driving Macroeconomic Reform; Turn Back to One Another – Rising Value of Care Work; World Without Money; Co-ops at the End of Capitalism

A new kind of communal living replaces the nuclear family. Massive inequality could drive the government to establish transformational domestic economic policies such as universal basic income. The challenge of meeting the diverse needs of people could incentivize innovative solutions and lead the way in creating greener, more equitable access for all. Automation and an aging population create an opportunity for people to return literally to caring for one another rather than competing for economic gain. Communities around the world could adapt and evolve further away from a profit-centered market economy to one based on exchange. This new economy would arise out of shared values and reinforce a sense of community connection. Pervasive automation and digital fabrication could help amplify innovative responses to inequality and rising communitarian dynamics. These changes support an emerging economy beyond capitalism.

5. Vegetarian Pandemic

Contributing Emerging Issues: Living Medicine; End of Meat in Global Food System

Society's slow recognition that eating meat is damaging to the environment and bad for health is not happening fast enough for some people. To hasten this transition, an eco-conscious biohacker could engineer a synthetic microbe designed to impart meat allergies to those infected. Should the infection spread widely, it could lead to the rapid, forced removal of meat from menus the world over. This could force the end of meat farming in unsustainably short time periods leading to the destruction of large numbers of animals and damaging rural economies. In the long run the environmental implications could be positive, but it would be unknown what potential side effects could arise from the disease.

6. Norton for Minds

Contributing Emerging Issues: Experts Training Machines; Biased Algorithms

AI/machines are already outperforming humans and will continue to surpass human capabilities. As their successes teach us new ways to do things and give us access to wider stores of saved knowledge than humans have ever had. AI brain implants will connect these capabilities directly to the minds of individuals. Giving the mounting U.S. rates of depression, anxiety, and suicide, a new personalized AI implant for mental wellness could be purchased at birth. It would be implanted in our brains to learn, evolve, treat, and assist individuals throughout the course of their life. Such systems could prevent challenges such as anxiety and depression and also find ways around learning difficulties and even improve cognitive performance.

7. Personalization Overkill

Contributing Emerging Issues: Death of Pricing; Interconnected Wearable Technology

These two EI will create multiple, shorter feedback loops coupled with dynamic pricing models run by different stakeholders. These feedback loops will affect not only consumer retail, but also health insurance, car insurance, and finance services.

With wearable tech, the system could monitor every action to feed dynamic pricing. Everything will be shifting dynamically all the time. The offspring of the *Progressive* car insurance tool that monitors driving, these systems will track, collect, and analyze everything. It may start with dynamically pricing insurance to match driving behaviors, lifestyle behaviors, eating choices, sleep, and stress. Given the growing burden of student debt held by the government, a system could even be put in place linking payback to future job earnings. This could create an ever-expanding system in which educational costs get linked in real-time to dynamically shifting assessments of future occupational and industry sector outlooks.

8. Hippie Extinction

Contributing Emerging Issues: Mainstream Health foods with Consequences; Return of Primordial Disease

The *Amazon-ization* of the health food industry and declining trust in expertise could lead to a mainstreaming of practices such as alternative medicine, anti-establishment healthcare, and anti-vaccinations. A larger number of people might delay seeking medical advice or refuse essential medications or vaccinations, allowing conditions to worsen. If the number of people being vaccinated decreases, the local herd immunity to certain diseases declines. This means an outbreak would hit harder, spread more widely and more quickly. Melting permafrost has already led to an outbreak of previously eradicated anthrax when long-dead reindeer carcasses thawed from the ice. As more permafrost melts, ancient or previously unencountered diseases could emerge, putting communities at risk of infection. If some people refuse vaccinations or treatments to combat such an outbreak, officials would find it difficult to contain the outbreak. This could lead to pandemics that could have been avoided if people adhered to medical advice.

9. Machine Healthcare

Contributing Emerging Issues: Techno-hubris in Health; Machine Charities; Distributed Autonomous Organizations

The push for ever more technological solutions to health combined with advances in AI-based diagnostic tools, resource management programs, and smart contracts—all propelled by Big Tech's further expansion into the healthcare sector—could lead to the creation of autonomous health corporations. An autonomous health corporation would be a fully AI-controlled organization—a corporation operating without any human intervention, built as software, and designed to follow uncorruptible business rules. Such a corporation could provide comprehensive, one-stop autonomous health care in three ways. One, it could tap and interpret the massive amounts of personal data generated every day by the IoT ecosystem to guide users toward healthier behaviors or products, or even preemptively provide healthier options. Two, it could provide instant consults and insurance quotes through AI diagnostic tools. Three, it could provide actual treatment through robotic surgeons and autonomous pharmacies. Autonomous health corporations could completely disrupt the healthcare field, from automating insurance companies to automating entire hospitals. Whether patients will accept a health system run by machines remains to be seen.

10. Merchants of Trust

Contributing Emerging Issues: Radical Transparency; End of Personal Privacy; Data Sovereignty

As trust in digital content and transactions, and in their providers continues to erode in the face of proliferating data breaches, hacks, deep fakes, fake news stories, and the weaponization of social media, a new push for transparency and privacy could lead to the creation of fully transparent and secure Trust Tokens. These tokens would certify content as true and unaltered, indelibly identifying the author. Similarly, as surveillance systems become more advanced, such tokens would help protect both the observed and the observers, ensuring that the data generated is unaltered by either party. As Trust Tokens become required for virtually all digital interactions, a whole new commodity market could open up, with Trust Tokens bought and sold by Merchants of Trust. The central importance of trust in tomorrow's digital world could even lead to such tokens becoming a dominant commodity or currency. In the healthcare sector, where trust and reputation are vital, Trust Tokens and Reputation Points could be used to ensure data is used transparently and accurately.

Exploring Broader Interactions

With a solid set of trends and emerging issues fueling explorations of the future, the next step is to consider how those changes might affect all the layers of life: the patterns of daily life, the systems that structure those patterns, and the values and worldviews that underlie those systems. Emerging issues can be sorted based on how mature they are and what layer – surface, system, or worldview – they could primarily affect. Another useful question to consider is where change might first impact spheres of human activity, using the Verge conceptual framework. Verge asks how changes affect how people think about the world, paradigms and mental models; or how people relate to each other, connect and move information, or how create, consume, and destroy goods and value in the world. Finally, it is useful to explore how emerging change brings new actors and influencers onto the stage and into prominence.

None of these individual analyses attempts to capture everything or be the final analytic word; rather, each represents a different lens through which to view change. Collectively, they enable a more comprehensive assessment of the changes identified and their potential interactions and impacts.

Layered Analysis

Layered analysis is an analytic tool developed by VFS to explore and better understand the changes occurring at different levels within society. As a framework, it recognizes that different types of changes occur within society and that these changes often happen at different rates. Layered analysis looks at the world in terms of three key layers: Surface, Systems, and Worldview.

The Surface layer looks at things as people experience them in daily life. Change at this layer tends to be frequent, often feels chaotic, and *typically* has a limited impact on society at large. The Systems layer encompasses and describes underlying mechanisms and structural features of reality like infrastructure, institutions (not individual organizations or agencies), and law. Change at this layer often takes longer; implementing change at this layer also tends to take more effort. The Worldview layer underlies all, consisting of the values, mythologies, and deeper narratives that are the deep roots of society and culture. Change at this depth can take generations.

Surface Layer

Surface layer recognizes that life is already too fast and too complex for the natural adaptive capacities of people. Aa growing deluge of information is ever more

insistent on attention, difficult to discern from misinformation, and increasingly targeted at consumerist and tribalistic impulses.

The systems people navigate in daily life, from workplace technology to healthcare to personal finances, are growing more complicated and their overlap more confusing. Spiraling demands on attention and a growing sense of threats to personal and digital safety are creating widespread stress and psychological dysfunction. These challenges are driving many people to seek active relief and a better sense of personal health in approaches ranging from the "quantified self," to the self-as-expert, to seeking solace in simplicity.

Systems Layer

Systems layer reflects important structural tensions between those systems that give business and government top-down control, and the emerging technologies and concepts for distributing power and diffusing control. Rapidly developing AI capabilities, the spreading internet of things, and growing mountains of data are permitting ever-more granular observation and influence of citizen behavior. At the same time, innovations in cryptography, digital fabrication, easier-to-use machine intelligence, and emerging biotechnology could potentially distribute powerful capabilities of creation (and resistance) to the smallest actors. In the long term, this may amount to a race between the development of these powerful new possibilities, and the weakening and possible collapse of the life-sustaining systems of society, namely the natural environment.

Worldview Layer

The worldview layer reflects that the U.S. has been experiencing a number of long-run intellectual undercurrents. These range from the spread of post-colonial and post-modernist thought across academia, to the gradual diffusion of "systems thinking" and holistic viewpoints across broader society. Intellectually, key beliefs that have undergirded decades of policy are shifting, including assumptions about rational actors in economics, about the unalloyed benefits of globalization, and about the inevitable global triumph of universal values and liberalization (and, not coincidentally, the U.S.'s world leadership). At this layer impending generational shifts in values as the U.S. moves towards a society with no ethnic majority. Finally, there is a sense that many people today view the world with greater anxiety and even fear. From 9/11 to the rapid demographic and cultural transformation underway to the sense of external threats from actors like China and Russia, more Americans perceive the world within and without as more threatening.

Looking at interactions *across* the three layers, there are some important interactions and dynamics to consider:

- With already overloaded daily lives at the Surface layer and with *accelerating* technological change occurring at the System layer, society runs the risk of inducing such extreme stresses of change on individuals and communities that it could experience irreparable fractures and dislocation.
- At the System layer, in terms of emerging technologies and economic models, a contest is emerging between the centralizing tendencies of incumbent institutions and the decentralizing possibilities pursued by startups and up-starts. This fight over innovation and society's architecture of the future will likely further unsettle experiences at the Surface layer, as well as amplifying certain value shifts at the Worldview layer.
- Between the System and Worldview layers, the underlying narratives and beliefs that once supported traditional institutions are weakening, and this weakening will continue.
- The rapid shift in values at the Worldview level, coupled with a deepening distrust of key U.S. institutions, will power a deep cultural turbulence. This cultural churn will feed and shape what ideas and innovations the next generation of social, economic, and political thought leaders pursue.

Figure 4 on the following page provides an illustration of some of the preceding analysis.

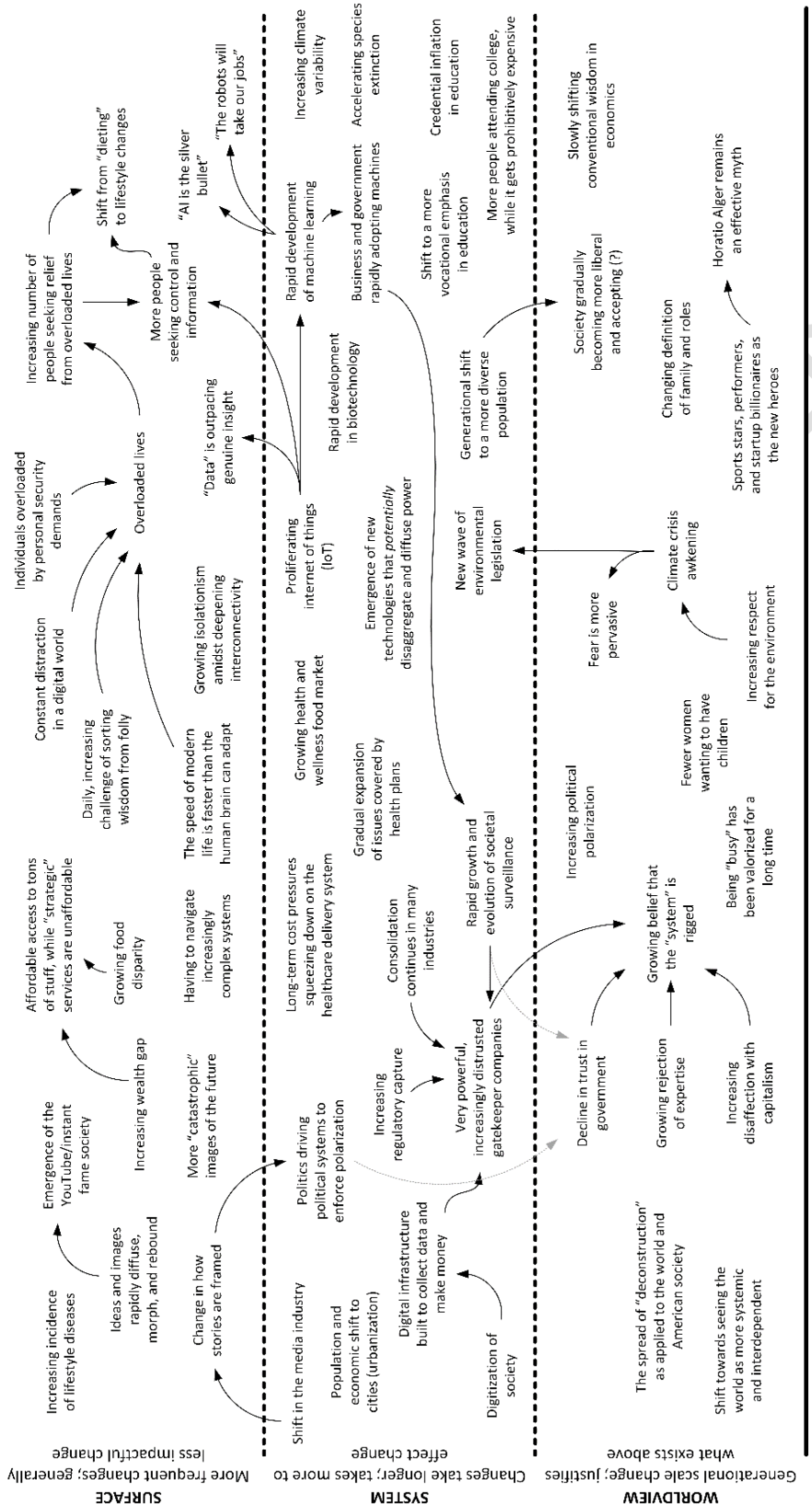


Figure 4: Visualization of the Layered Analysis

Verge Analysis

The Verge General Practice Framework for foresight was developed by Richard Lum and Michele Bowman as an alternative approach for framing and exploring change in society. The Verge framework explores six basic domains by asking questions regarding the origins and impacts of change:

- How might this change affect the concepts, ideas and paradigms **define** the world around us?
- How might this change affect how people **relate** to each other – how might it affect the social structures and relationships that link people and organizations?
- How might this change affect how people **connect** with each other – how might it affect the infrastructure and media people use to share information, meaning, and value?
- How might this change affect the processes and technologies through which people **create** goods and services?
- How might this change affect how people **consume** goods and services – how might it affect how they acquire and use them?
- How might this change affect how and why people **destroy** goods and value?

Define

The most striking immediate redefinition is fundamental – motherhood and parenting. 'Birthstrike', a Reactive Zone change observable today, highlights a value shift among young women who are deliberately choosing not to bring children into a world on the brink of disaster. In the Innovation Zone, conservative activism driving 'The End of Abortion Rights' could potentially challenge women's rights to make any of their own reproductive decisions. Erosion of reproductive rights is only a small part of value shifts and political redefinitions that could create 'An U.S. Authoritarian State.' By the time the innovations described in 'Redefining Childbearing' mature, reproductive rights could potentially be completely divorced from sex and gender, transforming worldviews about conception, gestation, and parenting.

'Automation Driving Macroeconomic Reform,' questions our fundamental understanding of the *labor—income—consumer* links in capitalism. This redefinition of core economic models is amplified in the Foresight Zone via 'A World without Money,' which suggests a potential future sharing economy that borrows from the barter, trading, gifting and sharing economies of other traditions.

A trio of digital emerging issues could redefine what people think is fundamental, moral, and ethical about living in a society that prioritizes data above everything. 'Data Sovereignty' could mean individuals ringfencing their core personal data,

redefining notions of data privacy, personal consent, and control of data as an inalienable right. In the public sphere, an evolving paradigm of 'Radical Transparency' suggests records of all interactions be public and verifiable – which would give consumers data leverage over institutions and corporations. Such transparency could help eradicate the embedded historical biases of public health analytics, as described in 'Biased Algorithms,' and perhaps redefine what humans consider 'normal.'

What other changes might emerge and transform mental models, worldviews, core concepts and values?

- Are people redefining faith and spirituality as values shift and society evolves?
  - Many faiths are struggling to adapt to a changing social environment. Some are experimenting, for example, the branches of the Methodist Church that are redefining who can be clergy, and what marriage can be.
  - Many individuals are questioning and redefining their own spirituality, and what it means to be religious. The number of people in the USA who say that religion is important in their lives has dropped; the number who say it is unimportant has increased.
  - The ambient culture has become more ecumenical in many ways; from winter holidays focused on Advent and Christmas, to a focus on a diversity of end-of-year holidays.
  - Yet people may need the bonds of shared faith more than ever – studies indicate that individuals who belong to churches are happier than those who don't (this may be an artifact of membership in communities and social networks).
- New definitions of health and well-being are arising:
  - The simple mechanical definition of health as 'all systems are functioning normally' is challenged by increasingly contested definitions of 'normal.'
  - From this primitive notion of health, could society come to emphasize well-being instead? Well-being as encompassing embeddedness in both social and environmental systems, embracing an ecological rather than a mechanical model of health. Will culture come to see that no true health exists without well-being?
  - With a continual redefinition of health, how much farther could the concept evolve in the next 20 years - what might 'health' include by 2040 that it doesn't include now?
- The New Normal will not be your grandmother's normal:
  - The historically biased definitions of what is 'average' and what is 'normal' are changing with demographic transformations. In youth under eighteen, people of color will outnumber whites as of 2020. Americans forty and under will be majority non-white by 2033. One result is that the politics of the young are increasingly accepting of diversity - more of them simply take cultural and ethnic diversity for granted.

- On a wider cultural note, the definition of 'liberal' is evolving: society is seeing ever-expanding definitions of what are acceptable components of identity, acceptable social behaviors, acceptable modes of dress, acceptable leisure pursuits, and other core components of personality and personal action.

Relate

In the Reactive Zone, 'It Takes a Village' signals an increased interest in community, connectedness, and communal living illustrated by more group home and co-housing arrangements. This could reinforce the Innovation Zone change "Turn Back to One Another," focused on the rise of the caring economy and inter-generational aid and support. Both changes support the rise of collaborative economic models as illustrated in the Foresight Zone by "Co-ops at the End of Capitalism." The overall arc depicts rising emphasis on personal inter-relationship and social connectedness.

Relationships of both equity and inequality could begin to shift with several changes in the Reactive Zone. As states legalize marijuana, many are declaring amnesty for prisoners jailed on minor drug offences. This 'Marijuana Freedom' opens up social and economic opportunities and potentially redresses some inequity. 'Mobilizing Menstrual Equity' describes reductions in regressive taxes on menstrual supplies that shifts economic inequities directly in lower costs, as well as indirectly in removing constraints on economic participation. A potential 'Male Birth Control Pill' shifts relationships among genders and could also reduce inequities of opportunity.

'Digital Alienation' suggests a growing isolation gap between those who can afford and access connectivity, and those who cannot. This gap could exacerbate inequalities all the while fracturing societies into the 'Digital Countries' emerging in the Innovation Zone. Yet immersive online worlds could also bring people together, as the Foresight Zone change of '"Everywhere" Living Online' describes, via collaborative interactive relations where categories and privileges are transient.

Challenges and innovations in political relationships and dynamics could accelerate due to 'Increasingly Extreme US Political Swings' in the near-term Reactive Zone. Increasingly polarized political relationships might concentrate tribalized animosity. Constantly shifting policies would weaken any attempts to address social ills and inequities. That could worsen considerably in the Innovation Zone as communities struggle with new residents, new relationships – and new animosities and tribalisms – as 'Climate Refugees and Adaptation' become more common. Some might respond by withdrawing into their 'Digital Countries' and online communities of interest. Finally, the Foresight Zone could see the emergence of new threats like 'Zoonotic Outbreaks becoming the new normal' as climate-crisis-impelled migration of people and animals generates new diseases. This would make people even more likely to withdraw into their own communities and suspect newcomers, and less likely to address societal gaps and inequities.

What other changes might emerge and transform how people relate to each other, to our communities, to other nations - and to the planet itself?

- How people of faith engage with and relate to their religious institutions could continue to fray under the pressure of scandals and corruption.
  - Problems of sex abuse and sex scandals have caused many to lose trust in their clergy and church institutions.
  - People are abandoning their religious institutions: the number of people who identify as members of organized religious institutions has slid from 75% in 1992 to 50% in 2019.
  - Perhaps because church membership is eroding, 76% percent of people say that religion is losing its impact on US society. This may be unique to religious moderates, as evangelicals are exerting more, and more organized, influence on US politics and policies.
- Personal relationships are evolving as well.
  - People are less likely to see others as merely economic resources or economic partners.
  - Families are restructuring. Divorce rates have decreased – but so have rates of marriage. More and more children are raised 'out of wedlock' and by single parents.
  - People are huddling together. Out of fear of violence and of 'the other,' some are moving to secure gated communities in a wave of enclavization, or residential protectionism. Others are exploring co-housing possibilities to provide social, emotional, financial, or creative support to each other.
- The relationship between people and the natural world is undergoing a tectonic shift – although perhaps not quickly enough.
  - The environmental movement together with concern for the climate crisis are transforming how humans relate to the planet, from the Biblical 'stewardship of nature' to a more holistic understanding of nature as a web in which people are also a part.
  - Rather than seeing nature as a bank of raw materials to exploit, new policies relate to nature as a provider of ecosystem services.

Connect

Innovations offer new media and conduits to transport and transmit ourselves, our roles, our play and our concerns. In the Reactive Zone, 'Automated Transport Networks' could radically reduce the time spent commuting, as transport becomes more efficient and faster. Transformations in transport could eliminate commuting altogether: automated transport pods could mean the journey is the destination, with mobile workspaces, cafes, hotel rooms, entertainment pods, and even mobile medical clinics.

‘Ready Player, Escape’ suggests an emerging future where people would not bother moving their physical selves at all, opting for immersive virtual environments instead. Digital platforms could become the primary conduits for humans to transfer information, value, meaning, and emotional connections. This could begin as an entertainment and leisure option, but if the economy falters, employment drops, and the climate crisis worsens, it could mature into digital addiction. An upside of immersive connectivity might be ‘Techno-Holistic Health Care,’ providing advanced health coaching informed by the intersection of biosensors, public health Big Data, and AI health coaches. The ability to rapidly collect, share, analyze, and broadcast both individual and public health insights could result in a renaissance of health and well-being society-wide. This could contribute to the more positive digital environment illustrated in ‘”Everywhere” Living Online.’

What other changes might emerge and transform how people connect to each other and across our activities - how do people transmit information and meaning, either by innovations in communications technology and systems, or shifts in our languages, or the novel new arts?

- Amplifications in social leverage:
  - A single individual’s capacity to create social movements and activate social change via digital social platforms will continue to expand.
  - Conversely, the expanding capacity of people to weaponize shame and target specific individuals via social platforms could create an epidemic of damaged identity and eroded well-being.
- Being more transparent about ourselves:
  - The evolving ecology of wearable health technology and biosensors could amplify health and well-being support groups by easy sharing of ‘quantified self’ data and achievements.
  - As our digital selves evolve, how people share them and connect with others could in turn evolve new art forms, providing new ways of communicating our inner and outer health.
  - The advent of embedded communication technologies could produce a practical form of techno-telepathy.

Create

In the Reactive Zone, ‘The New Job Market’ began as a promise of greater individual control over when and how to work, but the gig economy of flexible hours more and more often means much less financial security and much more stress. The ‘Collapse of a Generation’ illustrates how ‘The New Job Market’ combined with the after-effects of financial recession and crippling student debt could mean an entire cohort of young

people with no hope of creating their own careers, building homes, and starting families.

Given the epidemic of anxiety likely to result, it is useful that the Innovation Zone sees the possibility of 'Ending Pain and Anxiety through DNA', with gene therapy potentially altering our neurochemistry to offset stress and pain. That bio-tinkering evolves in the Foresight Zone to 'Editing Out Addiction,' which suggests genetic engineering could render addictive substances like nicotine and heroine benign. It might even be able to switch off the mechanisms of addiction in the human nervous system. These new genetics-based health services could be matched by creation of healthier and more environmentally friendly new food products, like the plants and bio-engineered proteins contributing to 'An End of Meat in the Global Food Supply.'

Combining biosensor data with genetic analysis could produce finely tuned 'Personalized Medicine' – dispensing with the concept of 'normal' entirely. This might result in therapeutic regimes and medicines with very few side-effects – but potentially at a much higher cost.

The Foresight Zone suggests this could evolve into 'Living Medicine' as people learn to bioengineer our microbiome to enhance health, support psychological stability, and even target specific bacterial and viral infections. As genetic editing becomes a basic literacy – like coding in the digital age – the hottest biopharmaceutical market could be in neighborhood garages. 'Kids Curing Kids' could put their home-built biolabs to work handcrafting highly personalized designer drugs for performance enhancement or stress relief. One emerging downside could be 'Techno-hubris in Health,' as entrepreneurs chasing the next medical start-up unicorn overhype unproven treatments and innovations, prompting a regulatory backlash.

The digital revolution and AI evolution will pace the biological revolution. As AIs' capabilities increase, they will increasingly outperform their human programmers and trainers in everything from diagnoses to disaster response, resulting in a world where 'Humans are Training Machines to Train Humans.' In this era, even philanthropic 'production' could evolve, based on advances in crypto-currency, blockchain, smart contracts, and AI. Networks of smart devices could generate money by selling excess system capacity and act as 'Machine Charities', donating those funds to philanthropies and projects that Big Data analytics suggest are most effective.

What other changes might emerge and transform how people produce goods, systems, services - and the next generation of citizens?

- People take greater creative control of their physical selves and well-being:
  - People could increasingly self-design both their health regimes and even their physical selves based on the advanced physiological data available to them.

- That wealth of data, combined with novel health technologies, could shift health practice from the expert to the individual, opening up the potential for DIY health care – and for even more divergence away from an arbitrary 'normal' for health.

- Evolving ecologies of health and well-being services:
  - Creating health would focus increasingly on understanding the interconnectedness of health and well-being with every aspect of our lives and our environments.
  - That increasingly pervasive shift to a holistic paradigm could support more innovative projects like Austin's Design Institute for Health. More communities might understand the need for broader social support for people who are ill at home; governments would understand the need for multiple and multi-layered strategies to address public health issues, eg, addressing the obesity epidemic via calorie display requirements and community-wide sports days and media messaging and school curricula.

- Creating consumables supporting health and well-being:
  - More and more food companies are working to reduce environmental impacts and health impacts in their consumer goods – premium products increasingly focus on fewer, purer ingredients.
  - Aggressively reducing waste at every link in the food supply chain could enhance the efficiency of food production and lower the overall ecological footprint of food supplies.

Consume

In the Reactive Zone, 'Sugar is the New Tobacco,' as a growing social backlash to the food industry's ubiquitous use of high-fructose corn syrup demonizes sugar as a primary driver of the obesity and diabetes epidemics. This raised awareness drives many people to shop for healthier alternatives, often in organic food co-ops, or stores like Whole Foods. These stores sell a lifestyle as much as they sell groceries. Consuming that lifestyle often comes with a side of consuming health conspiracy theories; these are 'Mainstream Health Foods with Consequences.' On a more positive note in the Innovation Zone, many people increasingly approach 'Diets as Medicine' and focus on mindfully choosing foods to improve both personal and planetary health.

But even good health draws to a close, and as it does more and more people are rethinking our society's traditions around death. The question is how to consume 'A New End of Life' experience – what would mindful palliative care and death care services look like if they maximized well-being for people and the planet? From that position in the Reactive Zone, people can leap ahead to the Foresight Zone and the emerging potential for 'Extreme Longevity for the Few.' What price another hundred years of life? Innovations in gerontology will radically magnify the current have/have-not gap in health care access and longevity.

Finally, one change with the potential to disrupt economic assumptions is the emerging 'Death of Pricing.' Dynamic pricing, which continuously resets the value for goods based on shifts in demand, location, and scarcity, results in highly personalized prices that could exacerbate inequity in access to goods and services. This could constrain who gets to consume what.

What other changes might emerge and transform how people consume goods, systems, services, information, and the arts?

- Popularity of faux health and quick-fix health products:
  - Increasing ageism, lookism, and health consciousness could create an upswing in voracious buyers of health 'quick fixes' – e.g., supplements, wearable technologies, fraudulent media 'experts,' etc.
  - Potential for rise of massive grey and black markets in unregulated, under-regulated, and regulated health and cosmetic services.
- Ecologically focused well-being:
  - Increase in personal sustainability movement, with more people converting lawns to suburban mini-farms, and supporting urban co-ops for metropolitan agriculture, etc.
  - Ecological movements and climate-crisis panic could normalize radical anti-consumption behavior, popularizing New Year's resolutions for year-long 'buying fasts'.

Destroy

In the Reactive Zone, the potential for a 'US Economic Recession' will destroy accumulated value and make more precarious the lives of the most vulnerable – the elderly, the disenfranchised, and young people already saddled with crippling debt. The Innovation Zone suggests that 'Elder Exploitation' could result, as the poor in elder
care are forced to work to reimburse institutions for the cost of that care. With the 'Disparity of Climate Crisis Impacts on Food' increasing food insecurity, people of all ages could be scrambling to assure their food supply.

'Climate Change Impacts the Health of the Most Vulnerable' highlights the possibility that as people destroy the planet, they also destroy historical health security gains from the last century. In fact, society potentially resurrects health risks from millennia past, with 'Zombie Viruses and Toxic Threats Emerging' from thawing permafrost. These could multiply existing risks from toxic landfills, industrial waste, and contaminated water that already disproportionately affect economically disadvantaged communities. 'Solving Waste Inequity' then becomes a critical challenge for assuring public health and safety are not destroyed. In the Foresight

Zone, the possibility of good intentions run amok is captured in 'Runaway Microbial Tribbles': bioengineered synthetic microbes designed to eat up waste, toxins, and discarded plastic could pose the risk of gobbling up everything else.

Finally, the 'End of Personal Privacy' could destroy self-sovereignty and affect everyone's ability to take action for change.

What other changes might emerge and transform how people destroy meaning and value in the world?

- Ongoing cultural emphasis on 'success' requiring a fast-paced life focused on acquiring wealth would continue destroying calm and contentment, eroding well-being.
- Ongoing emphasis on opioid approaches to pain management would continue destroying personal, community, and public health and well-being.
- Destroy opportunities for shelter by encouraging real estate wealth creation - accelerating homelessness due to heightened housing costs.
- Ultra-conservative influence of older generations could slow progress in realizing the inclusive social changes of future generations.
- Too great a continued focus on profit and consumerism could lead us into an irreversible climate crisis

The table on the next page maps the 51 emerging issues on a matrix of Verge categories by level of change maturity. This estimates where the first and highest impact of each change is likely to be felt. The following paragraphs describe how the emerging issues might generate changes in each of the six Verge categories and suggest how those changes might interact.

	Foresight	Innovation	Reactive
Define	42. World Without Money 44. Demographic Assumptions Overturned 46. Redefining Childbearing	17. Automation Driving Macroeconomic Reform 25. A U.S. Authoritarian State 28. End of Abortion Rights 31. Data Sovereignty 32. Radical Transparency 38. Biased Algorithms 39. Changing Under-standing of and Response to Racism	14. Birthstrike

	Foresight	Innovation	Reactive
Relate	40. "Everywhere" Living Online 46. Co-ops at the End of Capitalism 49. Zoonotic Outbreaks the "New Normal"	23. Turn Back to One Another 24. Climate Refugees and Adaptation 26. Digital Countries	2. It Takes a Village 4. Marijuana Freedom 5. Mobilizing Menstrual Equity 10. Digital Alienation 11. Male Birth Control Pill 12. Increasingly Extreme US Political Swings
Connect		35. Ready Player, Escape	6. Automated Transport Networks 16. Techno-Holistic Health Care
Create	42. Machine Charities 44. Living Medicine 50. Kids Curing Kids 51. Editing Out Addiction	21. Personalized Medicine 29. An End of Meat in Global Food Supply 33. Ending Pain and Anxiety through DNA 36. Techno-hubris in Health 37. Humans Training Machines to Train Humans	1. The New Job Market 13. Collapse of a Generation
Consume	41. Extreme Longevity for the Few	18. Diets as Medicine 27. Death of Pricing	3. Mainstream Health Foods with Consequences 9. Sugar is the New Tobacco 15. A New End of Life
Destroy	48. Runaway Microbial Tribbles	19. Elder Exploitation 20. Solving Waste Inequity 22. End of Personal Privacy 30. Disparity of Climate Crisis Impacts on Food 34. Zombie Viruses and Toxic Threats	7. Climate Crisis Impacts Health of Most Vulnerable 8. US Economic Recession

Figure 5: Sorting Emerging Issues within the Verge Domains

In Brief

The critical changes affecting each Verge category could result in the following:

- *Define*: emerging changes could potentially redefine motherhood and parenting; the labor-income-consumer links in the economy; rights of privacy, consent, and control over data; concepts of faith and spirituality; what is meant by 'normal' vis-à-vis health; and what is meant by health itself.
- *Relate*: emerging changes are creating opposing forces potentially affecting all human relationships: on the one hand, a resurgence of interest in community, social connections, and collaboration accompanied by decreasing inequality; on the other, the potential for rising digital inequity and exaggerated isolationism driven accessibility gaps, and fear of the newcomers and the other. Relationships to faith are less and less relationships to religious institutions, and people may increasingly come to see their relationship to nature as within it rather than outside it.
- *Connect*: new conduits for connection are evolving, in terms of automated transport to move physical selves and immersive virtual environments in which to transmit inner selves in avatars of our own design. High-volume collection and connection of personal data offers potential for new insights in public health, and the potential for single individuals to leverage connectivity and data access to create social movements and social change. The downside is a massively amplified potential for weaponized shame and social shunning, and for addiction to escape via virtual reality.
- *Create*: automation and 3D-printing are transforming how the economy creates goods and services and radically reducing the need for full-time labor, potentially generating an epidemic of stress and anxiety. Fortunately, medical innovations are creating new strategies for addressing addiction, fine-tuning personal medicine, and even enabling creation of DIY medical and health products. The rise of AI and networks of smart devices could transform how value is created by machines alone, as well as in concert with humans.
- *Consume*: heightened awareness of what goes into foods, and its effect on diet and health, has changed consumer emphasis from food as merely fuel and pleasure, to diet as medicine and as an ethical relationship to nature – that concern for the environment may surface throughout patterns of consumption. New biological capabilities offer the potential to rethink how people consume across the lifespan, whether by rethinking end-of-life experiences and services or by purchasing extreme longevity. Prices as a mediator between consumers and desired goods and services could become more and more fluid via adaptive pricing – which could also constrain who gets to consume what.
- *Destroy*: economic fragility could destroy accumulated value, in turn destroying personal financial security for many; continued destruction of planetary biosystems could in turn destroy many of the health security gains humanity has made; increasing data surveillance could destroy self-sovereignty. The overall impact of the trends and

emerging issues described in this report could be destruction of personal contentment, well-being, health, physical security, political self-determination, and the viability of the planetary biosphere and the future of subsequent generations.

The Verge framework assists in thinking through the impacts emerging changes could have on core components of human life; it is a reminder to think holistically about the impacts of change – to think beyond the observable, physical impacts to the media people use to transfer wisdom, knowledge, and meaning; to our relations with each other and the world.

Anticipating Novel Actors

The relationships of power and privilege surrounding an issue change as the issue evolves—potentially bringing in or even creating new, important actors. Building better futures requires identifying and working with these emerging actors. VFS used one of its original, in-house approaches for identifying novel emerging influencers, leaders, and stakeholders for the topic areas explored in this report. There are three categories of emerging novel actors: 1) direct descendants of current actors; 2) ideational descendants of current actors; and 3) completely novel actors.

Many of the emergent actors described here grow out of the ways in which digital technologies are transforming how people interact with each other. Most emergent actors have at least some connection with today's actors, but technological innovations are making wholly novel actors such as post-humans and robot citizens possible.

- **Direct descendants of current actors**—novel actors that form as a spinoff or offspring of an existing actor, potentially including:
  - **Data Rights Protection Bureau**—new government agency or department tasked with regulating the increasingly complex interactions between digital ecosystems and people to ensure data rights.
  - **Reinvented Hospitals—**distributed (or even nomadic) hospitals that make full use of IoT and other digital tools.
  - **Reinvented Agriculture**—insect farming, urban farming, and micro-farming.
  - **Specialty Care Workers for Ultra-Geriatrics**—care givers for the super long-lived.
  - **Biohacker Consortiums**—coherent groups of do-it-yourself biohackers formed from today's maker labs.
- **Ideational descendants of current actors**—novel actors that are shaped or influenced by an existing actor but are not directly connected to that actor, potentially including:
  - **Gig-Worker Unions**—unions representing flexible workers (Uber drivers, rent-a-coders, etc.).
  - **Fortress Communities/Retreat Communities**—ideologically coherent planned communities designed to physically exclude the other.
  - **Ad hoc government**—a new Congress for representing ad hoc constituencies, i.e. constituencies temporarily formed from nomadic communities such as climate refugee camps, congregations of self-driving homes, sea-steads or floating communities.
  - **Online Collectives**—coherent, self-organized online communities with economic power and resources.

- **Smart Cities**—cities capable of running and even policing themselves.
- **Trust Brokers**—Commodity trading companies or organizations for trading secure Trust Tokens to overcome deep fakes and data insecurity.

- **Completely novel actors—**actors without precedent, potentially including:
  - **Distributed Autonomous Organizations (DAOs)**—autonomous organizations operating without human input, which could include autonomous hospitals, machine governments, and machine charities.
  - **Post-Humans**—genetically engineered and/or cybernetically enhanced humans with abilities beyond those of normal humans, who could include immortals – people with extreme lifespans and health, and super soldiers.
  - **Digital Countries**—a coherent online community with a government, citizenship and relations with real world entities.
  - **Robot Citizens**—intelligent machines given same rights as human citizens.

Additional Building Blocks for Futures

Trends and emerging issues are not the only feedstock required for rigorous foresight. Whether building scenarios of alternative possibilities, or articulating visions of preferred futures, it is important to incorporate other information about the future: existing images, strategic uncertainties, major transformations, and potential surprises – wild cards. It is especially important to identify and acknowledge existing images of the future – whether possible scenarios or visions of preferred futures – that might compete with any images of the future people build as part of a strategic process. Identifying critical uncertainties helps bound the landscape of possibilities, while challenging people to imagine wild cards – high impact, low probability events – helps stretch our imaginations and identify potential blind-spots.

Competing Images of the Future

"Image of the future" is a broad term that encompasses both possible futures (scenarios) and preferred futures (visions). Several organizations have developed scenarios or forecasts illustrating how many of today's health-related emerging issues may play out over the next two decades. Many of the images are similar, often driven by the same trends and emerging issues, or by a certain belief in something, for example technology, that might shape the future. Often the same emerging issues and trends can be used to develop a positive scenario and a negative one. Analyzing these competing images helps to highlight some of the motivations of different stakeholders. This image analysis can also provide insight into how thinking is developing around emerging technologies, policies, and events.

When conducting this exercise, one usually looks for three or four specific images. The broad scope of this horizon scan, however, makes it difficult to identify only three or four images, even within one of the eight topic areas. So, using a different approach, this section provides an overview of competing images of the future identified in both the scan of scans and during the wider horizon scan for this report. Rather than listing all the specific images – for example, a world where AI brings positive change, compared to one where automation leads to mass unemployment – the main themes found across the competing images are summarized.

1. The Digitization of Health

Many scenarios identified include a trend toward the increasing digitization of health services, from the 'digital hospital' to digital personal health assistants. These images tend to be positive. Most include more distributed, automated, personalized health services driven by digital technologies and big data analytics. The nature of the scenario and degree to which technology plays a role in driving change often depends upon who developed the scenario. Most of these scenarios were written by Silicon Valley-based organizations and describe digitized,

connected, positive futures driven by advances in technology. In many of these futures various medical services are automated, from analyzing scans, to health monitoring, to surgery. Wearable medical devices provide constant health monitoring with results analyzed in real time by AI systems. The provision of healthcare is distributed to smaller facilities and medicine is more personalized, providing better care with fewer visits to medical professionals and dramatically lower costs. A shift to prevention, health, and well-being often accompanies this digitization, rather than merely providing medical care. In these futures, genetic testing and monitoring designed to target diet and prevention of health conditions rather than just treat them.

2. *Dramatic Technological Advances and Health Disparities*

Not all images depicting an increased role for technology are positive. In some images of the future growing inequality blocks access to advances in medical technologies to all but the wealthiest. These scenarios focus on the technologies that will not only improve healthcare and longevity but could also augment human performance, making people stronger, more intelligent, and hardier. In these scenarios the country becomes doubly divided, along lines of both poverty and access to augmentation. In some scenarios the wealthy, augmented humans live a better life while others are left behind, not only in poor health and poverty but also now markedly worse off by not being augmented. The dramatic advantages given to the wealthy through augmentation create a whole new dynamic to reinforcing inequity. Other, more negative scenarios suggest mandatory augmentation could be used for security, job or judicial purposes, as the state exercises control over the human body.

3. *Health Disparities Worsening Inequality*

Many trends identified in the horizon scan highlight the worsening access to healthcare and declining general health in poor, often ethnic minority communities. Type 2 diabetes and other chronic lifestyle diseases are higher in these communities, while rising costs and diminishing services are reducing access to healthcare. Many emerging issues point towards growing inequality, rising unemployment, growing health deserts, rising food prices and further reduction in services. Some images explore what society could look like if inequality continues to grow. These futures are bleak, characterized by poverty resulting in higher morbidity, mortality and reduced quality of life for poorer communities. In these futures a crisis in health and well-being faces poor communities, while at the other end of the spectrum advances in medical technology and well-being mean extended longevity and healthier lives for wealthy communities. In these futures, opportunities to rise out of poverty are dramatically reduced by poor health, malnutrition in childhood, higher infant and maternal mortality rates and lower

life expectancy. As communities become more economically desperate, underground or grey economies are expected to grow and criminality and violence rise. These futures are violent, controlled by gangs and organized criminality in communities driven into the outskirts of cities by rising costs. Richer neighborhoods of wealthy elites shut themselves off in gated communities and secure apartment buildings.

4. *Innovation Driving Greater Equality*

In these more positive futures, technological advances and new policies have improved equality in society. Innovations and widespread digitization of health services have reduced the cost of healthcare provision and improved access. New policies reduce the importance of wealth and earnings in society, for example, a universal basic income, or a shift in economic systems driven by automation. In these futures access to nutritious food, education, and healthcare are not dictated by economic level or ethnicity, and society is far more equal. These scenarios build on the promise of trends suggesting that younger generations are becoming more diverse and developing a stronger social conscience. Drivers such as racism and traditional values have less impact in these futures, allowing equality to improve along ethnic as well as socioeconomic lines.

5. *New Business Models and the Cost of Healthcare*

Many scenarios are explicitly built around different models for providing healthcare services. In these futures, healthcare service models can be divided into three main categories: market-driven solutions; social solutions; and state-driven solutions. In market driven solutions, private companies—technology and 'one-stop-shop' companies—provide the gamut of health-related services while making significant profits. With social solutions, business models shift from large-scale, top-down solutions to local, bottom-up solutions with various social networks promoting healthy lifestyles. The third model, state-driven solutions, envisions universal healthcare, with a shift to a government subsidized system similar to those in Europe or Australasia. Concern over the rising cost of healthcare is also present in many scenarios, most often driven by population aging, chronic illnesses, and advanced medical technologies and treatments remaining prohibitively expensive. Questions over the sustainability of current health systems is widespread. These futures cover both "positive" and "negative" images of the future.

6. *Altered Conceptions of Wellness*

These futures foresee a shift in perspective from treatment to prevention and from illness prevention to all-around well-being. These images include advances in technology to allow genetic manipulation, constant remote monitoring,

improved access to food, and promotion of healthier lifestyles. Technologies and policy shifts, such as roaming hospitals, telepsychiatry, and gene therapy have brought down the costs of healthcare provision. Changes to payment structures in support of healthy lifestyles and prevention have meant healthcare systems need to provide fewer treatments and their service burden is significantly lower. In these futures, shifts tend to result in enhanced standards of living and improved equality across society.

7. Beyond Capitalism

Some ambitious, positive images of the future paint scenarios further ahead in time. These are often built to counter the exploitation and disparity of the capitalist system and how it currently shapes society globally. In these futures, advances in technology and automation, as well as shifting attitudes, have eroded traditional power and governance systems and moved to societies beyond capitalism. These scenarios are usually characterized by better health, enhanced well-being, and equality. Communities are focused around contributions to society rather than economic growth.

8. Dystopian Society

Some of the more negative images of the far future arise from negative changes in governance, as government systems either break down or overreach. These include scenarios where advances in technology and increased automation have worsened inequality in society. Other drivers include environmental degradation and climate change that lead to food shortages, mass migration, increased violence and drastically reduced health and well-being for poorer, particularly ethnic communities. In these futures, the gap between rich and poor has become a chasm. The majority of society live in abject poverty while a very small percentage of wealthy elites live long, healthy lives separate from everyone else, supported by innovations in medical research and advanced technologies. In some of these futures traditional governance has collapsed, leaving the poor to live in anarchic societies characterized by violence and insecurity. In others, authoritarian surveillance governments have come to power, limiting freedoms and human rights, and controlling communities through high-tech surveillance.

Implications

Stakeholders

The analysis depicts the roles of different stakeholders. This begins with those who benefit most from keeping the system as it is or driving change in a specific area and have the power to do so. Other stakeholders may have less power but strong voices and significantly different motivations. For example, big pharmaceutical companies

benefit from keeping the system the same and continuing to find ways to maximize profits; while communities with fewer resources would benefit most from universal healthcare. The big pharmaceutical companies are far more powerful than the low-resource communities and so it is easier for them to influence or block change.

Assumptions

Various stakeholders also make assumptions that encompass different perspectives on how best to achieve their preferred futures. For example, with regards to governance, some stakeholders believe increased government involvement is essential to drive positive change, while others consider government interference will only lead to dystopian scenarios. Such assumptions are essential in creating useful scenarios for the future of health and well-being.

These assumptions might include:

- Good governance will be essential for positive futures;
- Bad governance will lead to negative or dystopian futures;
- Technology use will increase and will generally improve healthcare provision;
- Finance structures are key to the kind of futures created;
- Inequality generally has a negative impact; and
- Automation will increase with rising unemployment.

Stumbling Blocks

The images also help to identify stumbling blocks that could prevent a particular technology, treatment or policy driving positive, significant change. The key stumbling blocks identified in the scenario analysis include:

- Government regulation, both state and federal;
- Finance, particularly how models are financed and accessed, e.g., for R&D into technology;
- Attitudes to change that can slow the uptake of a new system, technology or structure, and slow progress;
- Legacy infrastructure built for a previous era but expensive and complicated to change.

Any work towards preferred futures of health and well-being must take into consideration the lessons learned from analyzing competing images of the future. Many of these perhaps ignore or marginalize some of the most important stakeholders, such as cultural communities, while focusing too much on established, dominant culture actors. An understanding of finance structures, funding for

research, and the role of both money, government, and other stakeholders is also critical in creating futures for health and well-being.

Strategic Uncertainties

Given that predicting the future is impossible – chaos and complexity theory tell us that – change can only be discussed in terms of bands of uncertainty that widen the further society moves into the future. Identifying what might be critical uncertainties relevant to the future of health and well-being can help map the full range of possible outcomes to explore for rigorous strategic thinking.

The strategic uncertainties identified during the scanning and outlined below can largely be grouped into four main categories:

1. **Uncertainties around technology—**impacts and diffusion/access
2. **Uncertainties around governance and the healthcare system—**policy changes
3. **Uncertainties around health and demographics—**changes in the burden of disease, demographics
4. **Uncertainties around the environment—**climate change and ecosystem health

While there are many potential sources of uncertainty, the uncertainties identified here suggest that technology in particular represents a significant source of uncertainty, as many potentially transformative technologies are still in development with their ultimate impacts unknown. The direction of health-related policies in the U.S. as well as the government's overall ability to function effectively is another primary source of uncertainty regarding future health and well-being. Demographic trends are generally considered less uncertain than most, but here too, the direction of fertility and immigration trends could have a significant impact on the future economy. Today's environmental uncertainties have less to do with direction—all indicators suggest increasing environmental damage—than with the uncertainty concerning the pace and severity of impacts from environmental damage. Such impacts could disrupt health systems around the world and thus have the potential to be on par with technology in terms of impact.

Technological Uncertainties

- **The rate of technological advance**
  - While current technology trends point to accelerating innovation (particularly in the digital and biotechnology fields), this is not a given. Technological innovations often come in waves, and between those waves, innovation can stagnate. It is an open question whether today's ICT and biotech waves will continue to increase or come to a crest over the next few decades.

- **The impact of AI**
    - Will artificial intelligence prove as transformative as forecasted, or will it remain limited only to specialized applications? A world where researchers achieve strong AI (human-level or greater intelligence) would be significantly different from one where researchers create such a breakthrough.
- **The accessibility/diffusion of new technologies**
    - Whether tomorrow's technologies diffuse around the world and are easily accessible to people from all socioeconomic backgrounds or are only available for the select few in rich countries, will have a major impact on the health and well-being of the general populace.
- **The level of disruption from automation**
    - The automation of manufacturing jobs has already had a significant impact on the U.S. economy, as well as health and well-being. The potential automation of millions more jobs, particularly white-collar and expert jobs, amplifies this potential to undercut health and well-being. This is particularly true if not countered by new social safety nets like universal basic income.
- **Human genetic testing**
    - It is an open question whether genetic testing proves as useful and central to healthcare as expected, or whether it can only help in limited, specialized areas.
- **Human genome editing**
    - Uncertainty also exists around the effectiveness of human genome editing—i.e. are too many genes involved to reliably produce designer babies? This is amplified by uncertainty as to its social acceptability - whether human genome editing could become mainstream in U.S. society. A world with effective, widespread human genetic engineering would look very different to one where only a few have access to the technology or where the technology is never as useful as predicted.

Governance and Healthcare Uncertainties

- **The future of the Affordable Care Act**
    - The repeal of part or all of the Affordable Care Act could jeopardize insurance coverage and Medicaid coverage for millions of Americans, resulting in a loss of access to healthcare and a worsening of health outcomes.
- **The direction of the U.S. political system**
    - Whether the U.S. political system continues to degenerate, stabilizes, or becomes more effective will impact the government's ability to address a range of health and well-being concerns, from climate change to offsetting impacts of automation.

- **The political affinity of younger generations**
    - Current trends suggest that young people are becoming more politically liberal and more open to cultural issues like keeping abortion legal and changing gender norms. Will this shift hold, or will today's young grow more conservative as they age, as earlier generations seem to have done?
- **The direction of U.S./Global Economic Growth**
    - The pattern of economic growth – rapid gains, volatility, or recession—can have major impacts both for the health system (funding for healthcare) and for personal health (mental health outcomes).

Health and Demographic Uncertainties

- **Discovery of new antibiotics**
    - Can new antibiotics (or other methods of treating infections) be developed quickly enough and at sufficient scale to avoid massive deaths from increasingly resistant infections? A society without effective antibiotics would see dramatically worsened health outcomes.
- **The balance between prevention and treatment in the healthcare system**
    - The U.S. healthcare system currently favors treatment over prevention. A dramatic shift toward prevention could drive a major overhaul of the healthcare industry (and the larger economy, thanks to healthier workers). At the same time, an amplified emphasis on more treatment and less prevention might drive up health costs.
- **The prevalence of lifestyle diseases**
    - The prevalence of lifestyle diseases could continue to increase, swamping the healthcare system. In contrast, a shift toward prevention, combined with new treatments and changing lifestyles, could significantly reduce this burden. These possibilities could have a dramatic impact on the nation's health as well as the amount of funds available for advancing medical innovations and treatments.
- **Changes in reproductive rates**
    - Current trends suggest that the decline in fertility rates in the U.S. (and around the world) will continue. How low fertility rates go or whether they rebound in the future, will have a major impact on U.S. demographics, economics, and health. A rapidly aging population will have different health and economic needs than a younger, rapidly growing population.
- **Changes in dependency rates**
    - The U.S. population is aging, with more people entering retirement and fewer young people entering the labor force. A continuation of the current trend will

drive significantly increased health spending as late-life interventions are more expensive. An increase in fertility rates and or immigration levels could invert this picture, with a baby-boom requiring very different resources than an elder boom.

Environmental Uncertainties

- **The severity and pace of climate change disruptions**
  - The success of mitigation and adaptation efforts will depend on how much lead time society has before major disruptions. The world would look vastly different under a scenario of rapid climate destabilization over the next 10 to 20 years versus more gradual change over the next 50 to 70 years.
- **Ecosystem collapse**
  - With species extinction from pollution, habitat loss, and climate change accelerating, will the loss of a keystone species (like honeybees) cause entire ecosystems to collapse? How widespread could the damage become?
- **Disruption of the global food supply**
  - Whether caused by pests, climate change, loss of pollinators or a genetically engineered plague, the world's food supply, particularly industrial-style mono crop agriculture, is quite vulnerable to disruption. Even small disruptions could have significant impacts for the health and well-being of the neediest, while large scale disruptions could lead to famine and instability.

Major Transformations

The foresight building blocks identified and explored in this report are not occurring in isolation to each other. Many share the same driving forces, and many more have the potential to combine in unexpected, transformational ways. In this section, nine possible transformations are outlined that could disrupt wide swaths of society, including health and well-being. These nine issues were developed as part of an exercise intended to explore the futures of health and well-being from a completely different direction, and thus generate unexpected insights. The nine major transformations are explored in-depth in Appendix E.

Digital Fabrication — *using machines to design and build individually, precisely, and quickly*

Advanced digital fabrication tools have the potential to produce virtually any object or device from basic feedstocks and digital plans. The result could be a dematerialized global economy with digital files being traded and production of

goods being done locally. Digital fabrication tools could also greatly improve equitable access to consumer goods and could even transform human health through the printing of on-demand, rejection-less organs for transplant.

Snapshot

- Digital design
- Computer controlled machines
- 3D printing
- New Feedstocks
- Dematerialization of trade
- Flexible and customizable manufacture
- Empowers individuals and small groups
- Organ and tissue printing

Environmental Breakdown — *our physical environment destabilized*

Human demands on the environment are exceeding the absorptive and productive capacity of global ecosystems and undermining the very ecosystem services on which civilization and nature depend. Current trends suggest society may be nearing a tipping point beyond which many natural systems will be unable to recover.

Snapshot

- Climate change
- Habitat destruction
- Pervasive contamination
- Urbanization and littoralization
- Environmental refugees
- Most populous and critical areas at particular risk
- Most vulnerable populations at most risk
- Increasing food insecurity

Rise of Competing Points of View — *a growing struggle for identity, truth, and culture*

As the global center for economic gravity shits East with the rise of China, Western culture's hold on global attention could slacken while previously marginalized cultural voices and points of view gain prominence, providing a useful critique of currently dominant assumptions.

Snapshot

- Generations of people with more education and access to information
- Shifting global center of gravity (economic and cultural)
- Increasing influence and intent of China to be an alternate pole
- Greater exploration of alternatives and synthesized views
- Expectation of continued expansion of social protections
- Increasing cultural tensions and fragmentation

Machines — *the built environment becomes its own ecosystem*

Today's Internet of Things has the potential to become an ever-expending, ever-more complex ecosystem of autonomous and intelligent machines, where machines no longer merely provide basic services (smart home monitoring, autonomous transport) but also companionship (caretake robots, AI/robot pets/friends), warfighting, and even human augmentation (nanomedical bots and cybernetic implants).

Snapshot

- Sensors, networks
- Data
- Machine Learning
- Robotics
- Human augmentation
- New scientific and medical horizons
- Machines as independent actors

Post-Scarcity Economics — *building a society without want*

Should sophisticated, easy-to-use digital fabrication tools ever become widely available, the potential exists for every person to become a producer/designer/prescriber and for every product to become opensource/generic. Universal access to goods, the undoing of intellectual property, and the loss of jobs that could result could undermine the current economic system and necessitate new forms of post-scarcity economics and societal organization.

Snapshot

- Digital fabrication
- Sharing economy

- Growing dissatisfaction with current economic assumptions and practices
- Growing concern about economic trajectories
- Shifting generational values and expectations
- Renegotiation of social compacts
- Redefinition of core economic concepts like capital and property rights

Privacy, Data, and the Right to Self — *Who has access and influence over your actions and preferences?*

The confluence of data hacking, ubiquitous sensors and drones, and the quantification of all aspects of life, is likely to make maintaining personal privacy harder and harder while empowering those who control access to such information. Advances in AI and quantum computing could potentially end privacy altogether.

Snapshot

- Business models where you are the product
- Businesses and governments building systems to collect data and to predict and incentivize behavior
- In a digitized society, every interaction is a potential risk
- Surveillance nations
- Algorithmic governance
- Human ingenuity turning towards evading and foiling surveillance

Rise of Authoritarianism — *wanting, promising, and maintaining power and control*

After half a century of increasing liberalism, values and the political pendulum seem to be swinging back towards isolationist attitudes that demonize 'the other,' accompanied by a desire for the reassurance of strong authorities. Such a swing could lead to the rise of more authoritarian governments, placing freedoms at risk, making already vulnerable and marginalized groups even more vulnerable, and jeopardizing global cohesion.

Snapshot

- Resurgence of authoritarian regimes around the world
- Increasing tribalism, nationalism, and populism—and decreasing empathy
- Increasing militarization and use of paramilitaries
- Increasing intolerance and violence

- Regression on issues of social justice
- Fragmenting of societies just as collective action will be most needed

Synthetic Biology — engineering new lifeforms

Advances in genetic manipulation tools are enabling scientists to not only edit existing lifeforms but to create entirely new, synthetic organisms. Such innovations are making possible a wide range of potentially transformative applications, from using microbes to produce pharmaceuticals and biofuels, to creating pollution-eating machines and organic, programable microbots.

Snapshot

- Individually tailored medicine
- Designer babies and human modification
- Living machines
- Biology as factory
- Ecological disruption
- Ecological remediation
- Synthetic plagues

Rise of the Self-Organized — *the politically decentralizing possibilities of technology*

Social networking, crowdsourcing, and real-time monitoring tools have the potential to spawn new forms of people power like self-organized communities and movements able to challenge and even supplant the state

Snapshot

- Online collectives
- Social media-powered protests
- Virtual nations
- Anyone and everyone can organize to pursue whatever end
- Increasingly fragmented populations
- Further erosion of the authority and power of the nation-state

Wild Cards

In considering how the future could differ from today, it is important to consider both the developing trends and emerging issues that could drive change as well as potential "wild cards." Wild cards are those seemingly low probability events that, if they were to occur, have the potential to create widespread, disruptive change. History teaches us that surprises are inevitable. Imagining potential wild cards can help future-proof our thinking and eliminate potential blind spots. In this way, wild cards often indicate more about our unconsidered underlying assumptions than they do about rigorous assessments of probability. That being said, the most useful wild cards are those events that: a) are truly transformative; b) have at least some probability of occurrence; c) allow for some form of human agency (i.e. events that can be mitigated against, avoided, or even embraced, and not unavoidable cosmic zaps like the Sun going nova); and d) have some probability of occurring within the next 100 years.

The wild cards identified here fall into one of four categories (societal, health, technological, and environmental) based on where they originate (e.g. a massive cyberattack begins as a technological event), but all are highly transformative events with impacts that ripple across all of society. The majority of the wild cards involve the impact of technology on humanity—in the ways people relate to each other and/or in what it means to be human. A significant portion also deal with breakdowns in society through conflict or the collapse of political and economic systems.

VFS worked with members of the FORESIGHT Design Team to generate an initial exploration of potential wild cards. This section outlines those wild cards along with others from VFS's own in-house analysis. See Appendix E for a full list of wild cards.

Societal Wild Cards

- The U.S. Civil War
  - Physical, violent conflict breaks out between the political left and political right in the US
- Global Economic Collapse
  - A new Great Depression—worse than the 2008 Great Recession—as economies around the world shrink and global trade grinds to a halt
- Happiness Quotient Replaces GDP
  - A redefining of how society measures societal development
- Nuclear War
  - A nuclear exchange between nations that causes massive destruction and potentially triggers a nuclear winter

- Machine Government
  - Governments run by autonomous systems without human intervention
- No More Secrets
  - New technologies not only end privacy, but also encryption and any other means of concealing data

Health Wild Cards

- Sperm Count Reaches Zero
  - Humans unable to reproduce without advanced IVF methods
  - Forced Euthanasia
  - People only get an allotted lifespan and no more
- End of Illness
  - Health in a pill makes everyone happy—no more sickness
- Radical Longevity/Immortality
  - Humans with no limit to lifespan

Technology Wild Cards

- Genetically Engineered Empathy
  - Humans with empathy toward others programed into their DNA
- Major Cyberattack
  - A widespread cyberattack that shuts down all of society (overloading power grids, water infrastructure, communications, etc.)
- Nuclear EMP
  - A high-altitude detonation of a nuclear warhead causing continent-wide disruption of electronics
- Strong AI Explosion
  - Major advances in AI lead to superhuman intelligent AIs that make humans obsolete
- Nanotech Explosion
  - Major advances in nanotech make atomic-level replication possible, putting an end to scarcity

Environmental Wild Cards

- Successful Geoengineering
  - Solar shades or other planet-scale engineering projects are successfully used to defeat climate change
- Global Environmental Collapse
  - Ecosystems around the world collapse along with mass extinctions, disrupting the natural systems on which civilization depends
- Extinction of pollinators
  - Bees and other vital pollinators go extinct, greatly impacting world food supplies.
- Rapid/Extreme Sea Level Rise
  - Sea level rise from climate change happens much more rapidly and at higher levels than expected, displacing hundreds of millions of people
- Unsuccessful Geoengineering
  - A failed planet-scale engineering project triggers widespread ecological damage (e.g., global acid rain from a failed sulfuric acid injection into the atmosphere)

Conclusion

The possibilities for health and well-being in the U.S. covers a broad range of futures, with a vast array of factors that could influence well-being over the next thirty to fifty years. This exploration of changes that may shape well-being in the future balanced capturing a broad view of the landscape with practical limits on data gathering.

Based on recent trends, as well as observations of the challenges that individuals and organizations are experiencing today, the U.S. has entered a period of increasing complexity and stress. This period will witness worsening inequalities (e.g. wealth, income, and housing) and deteriorating health outcomes (such as lifestyle diseases, maternal mortality, mental health, and lifespans), combined with increasing environmental hardships. These changes are occurring just as the country begins a significant generational shift towards increasing diversity and liberalism, rising secularism, and changing life stages, compounded by rapid technological change.

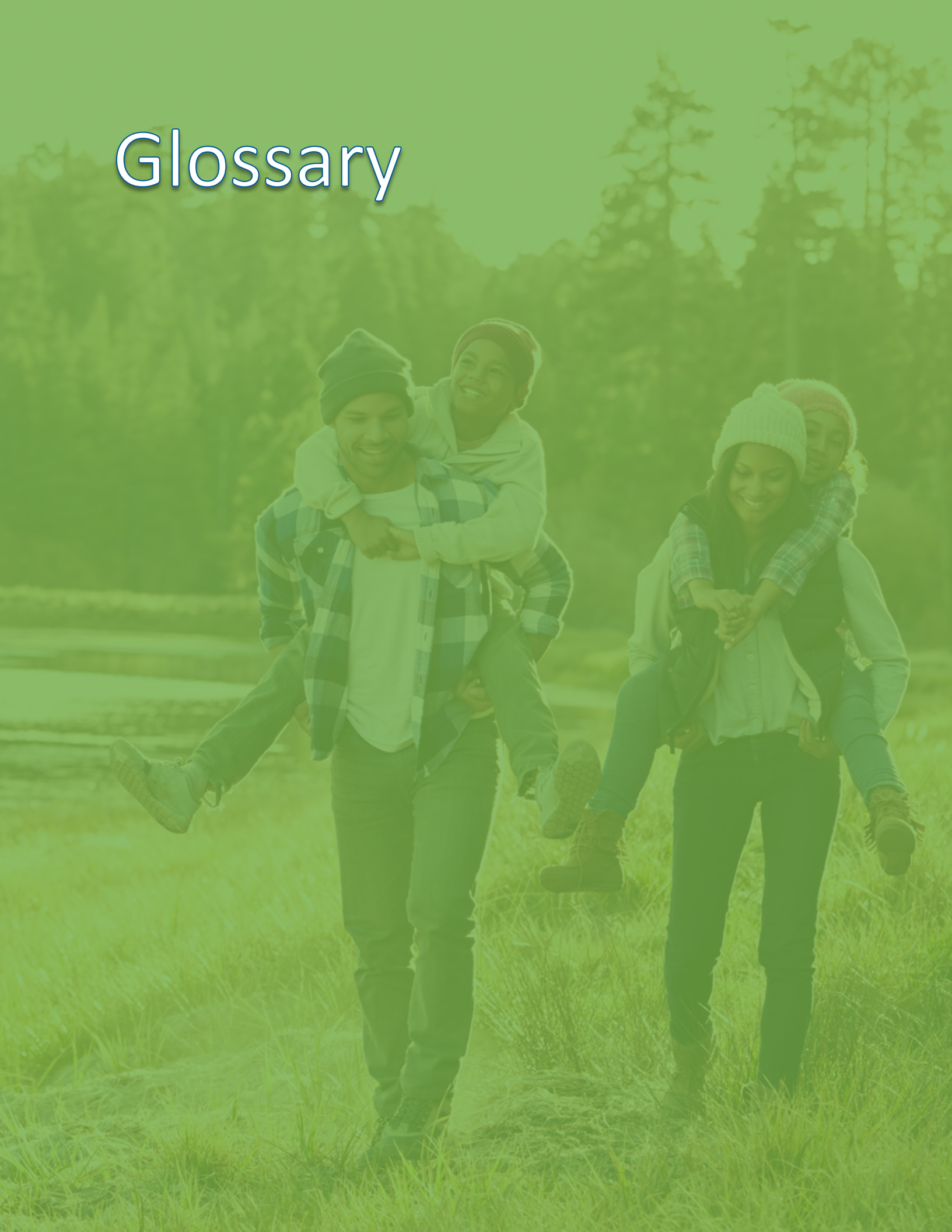
This period of turbulence could result in the U.S. "locking in" its current trajectories of inequity and inequality, squandering the chance of dramatically improving health through transformative new healthcare and new social arrangements. It also suggests emerging opportunities. For example, a new generation concerned with inclusion and sustainability, wielding powerful new tools, could introduce new solutions to the challenges surrounding health and equity.

Some of our specific conclusions include:

- Daily life is already overloading the natural adaptive capacities of people; with accelerating rates of change, this will worsen and worsen daily stress.
- Innovators are fighting a critical contest right now over technological innovation and the future architecture of society: daily life will be defined in important ways by who designs and controls the Internet of Things, the collection and ownership of data, and the ecosystem of machines that surrounds us.
- Emerging technologies such as machine intelligence and biotechnology represent a significant source of uncertainty for the future of health and well-being; many potentially transformative applications are still in development, with their ultimate impacts unknown.
- Long-run trends show America becoming, generally, more liberal in its values and more expansionist in its sense of who has rights and entitlements; this suggests that as those Americans born after the year 2000 become economically and politically active, they will dramatically tip the balance of values and worldview that guides innovation, business, and policy.
- The climate crisis that is only now rising to the forefront of mainstream conversations will impact every facet of life, figuratively and literally swamping society; few apparent upsides exist to such monumental environmental change, while many clear downsides do. That will further stress those populations that are already at-risk and marginalized.

Ultimately, many of the trends we see today point towards worsening outcomes in the future. Many indicators are negative. And yet on the horizon new technologies and ideas are emerging that offer positive, even inspiring possibilities. These represent potential only; none of them are guaranteed to mature or to find widespread adoption. All will have unintended consequences – some good, some bad. Given how power is distributed today in American society (e.g. the healthcare industry, food industry, big tech, and the industry energy), and given how powerful stakeholders have traditionally made the choices that shaped American wellbeing, drifting on the rapids of change is not tenable. A strategy of "muddling through" or passively allowing the future to unfold will not secure a more desirable state of health and wellbeing, particularly for our most vulnerable and marginalized communities.

Glossary



Driver: development producing major change; may be an emerging issue, a trend, or a megatrend (see *megatrend*).

Effects: this term loosely encompasses all the linked changes that change itself causes: mapping the effects of change in essence looks both at the result of the cue ball striking the racked balls, and also at the subsequent motion of the billiard balls as they rebound off the table walls and each other. As differentiated from ***impacts***: this term, on the other hand, loosely encompasses how all the players involved feel about the effects of the cue ball striking the racked balls. The "impacts" of change are our evaluations of all the effects of change - and thus vary from person to person.

Emerging Issue: any new technology under development, potential future public policy issue, or new concept or idea that might be fringe thinking now but which *could* mature and develop into the mainstream; usually encountered as “weak signals” in the present. Also known as ‘weak signals’.

Foresight: insight into how and why the future may be different from the present.

Futures Studies: a trans-disciplinary, systems-science-based approach to analyzing patterns of change in the past; identifying signals of change in the present; and extrapolating alternative scenarios of possible outcomes in the future; in order to help people articulate and create the future they desire.

Horizon scanning: the research strategy of reviewing a broad range of information sources across all fields of investigation (STEEP / EPISTLE / PESTLEC) in order to glean data about emerging sources of change; also known as *environmental scanning*.

Image of the future: an imaginary description (in any format or media) of a possible future outcome for a given item of interest: a person, a community, an organization, nation, society, bioregion, planet, etc. An infinite number of possible images of the future exist. This futures concept is related to the notion in physics of alternate universes.

Megatrend: commonly used to indicate a widespread (i.e., more than one country) trend of major impact, composed of sub-trends that in themselves are capable of major impacts. More precisely, a cluster of related trends which reinforce each other and together form a ‘super-trend’, of which the best example is perhaps globalization: the cluster of related trends in production, infrastructure development and linkage, labor mobility, capital mobility, worldwide IT capabilities, etc., all of which tend to reinforce each other's growth through a complex system of interrelationships allowing feedback and feed-forward.

Mission: an organization's purpose, often articulated as a statement describing how the organization is configured to achieve its vision and thereby serve the needs of its customers.

Racism: Racism is a system of oppression perpetuated by policies, practices, cultural representations, and other norms that produces racial group inequities by allowing privileges associated with "whiteness" and disadvantages associated with "color" to be codified, adapted, and furthered over time. It has been a feature of the social, economic, and political systems in which we all exist and backed by legal authority and institutional control. (Adapted from Ibram X. Kendi's book *Stamped from the Beginning* and The Aspen Institute: Roundtable on Community Change.)

Scan source: a documentable source of information about change; it may be published (newsletter, journal, magazine, conference proceedings, book, newspaper); online (website, weblog, e-journal, bulletin board, discussion group); broadcast (TV, radio); or live (focus group, conference, interview, personal conversation), as long as it is documentable.

Scan hit: a datum (fact) providing information about an emerging issue, trend, or driver of change. Ideally, a scan hit identifies an emerging issue that is objectively new even to experts, confirms or is confirmed by additional scan hits, and that has been identified in time for social dialogue, impact assessment, and policy formation.

Scenario: a technical term generally used to describe an image of the future deliberately crafted for planning or foresight purposes. It should be rooted in identifiable trends or emerging issues data extrapolated and organized using an explicit theory of social change. It should describe how changes created the particular future out of the past, and offer a vivid, provocative, accessible picture of how the future differs from today. Scenarios are often evaluated in terms of plausibility and probability; they should contain both opportunities and threats – they are statements of possible future outcomes.

Scenario building: the process of combining data about change – trends, drivers, emerging issues, and their potential impacts – into a coherent, logically consistent narrative describing the world at a specified future time. Over two dozen different approaches exist.

Strategy: a concept or theory for how, in a given context and employing a given set of resources and competencies, you expect to achieve your goals.

Trend: a measurable change over time; historical.

Verge Ethnographic Futures Framework: developed by Dr Richard Lum and Michele Bowman, this was originally used as a taxonomy to categorize scan data. Where *STEEP* (social, technological, environmental, economic, political) categorizes change by the point of *origin*, Verge categories change by its point of *impact* on people: does the identified change affect how people define themselves or other things? Does it affect how people *relate* to each other, or nature, or the built environment? Does it affect how people *connect* to each other, technologically, artistically, or in language? Does the change affect how people *create* and produce things? Does it affect how people *consume* things? Does it affect how people *destroy* things? Now widely used as a discussion and critical framework during all phases of futures research, not just as a categorization system for scan data.

Vision: a technical term used to describe an image of the future that articulates an individual's or group's most closely held values, most cherished ideals, and most preferred goals in a positive statement of a preferred future outcome.

Wild cards: low probability but high impact changes – like a global plague, or the invention of table-top fusion – usually described as events rather than gradually unfolding changes. NOTE: they may be very positive, very negative, or mixed in effects and impacts. Now often referred to as 'black swan events' after Nicholas Taleb's book, *The Black Swan*.

Appendices

Appendix A: Trend Sources and supporting Data

Appendix B: Emerging Issues Supporting Scan Hits

Appendix C: Raw Scan Hits Database

Appendix D: Historical Timelines

Appendix E: See Separate Document: Major Transformations

Appendix A: Trend Sources supporting Data

Trend	Supporting Sources and Data Sets
1. Accelerating Biodiversity Loss	⊙ Ceballos, Greardo et al. 2015. "Accelerated Modern Human-Induced Species Losses: Entering the Sixth Mass Extinction." *Science Advances* 19 https://advances.sciencemag.org/content/1/5/e1400253/tab-figures-data ⊙ Center for Biological Diversity. "Human Population Growth and Extinction." https://www.biologicaldiversity.org/programs/population_and_sustainability/extinction/index.html ⊙ International Union for Conservation of Nature and Natural Resources. 2019. "Red List: Summary Statistics." https://www.iucnredlist.org/resources/summary-statistics ⊙ New York Times. 2019. "Civilization is Accelerating Extinction and Altering the Natural World at a Pace 'Unprecedented in Human History." https://www.nytimes.com/2019/05/06/climate/biodiversity-extinction-united-nations.html
2. Climate Change is Becoming Increasingly Costly	⊙ NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2019) https://www.ncdc.noaa.gov/billions/
3. Spreading Microbial Resistance	⊙ NPR, 2018. "Surge in Antibiotics is a Boon for Superbugs." https://www.npr.org/sections/goatsandsoda/2018/03/26/597014559/surge-in-antibiotics-is-a-boon-for-superbugs ⊙ Data for Antibiotics Use Graph: Center for Disease Dynamics, Economics and Policy https://resistancemap.cddep.org/AntibioticUse.php ⊙ Medscape.com. 2018. "Rate of Antibiotic-Resistant Infections Doubled Since 2002, Cost Tops $2B Annually." https://www.medscape.com/viewarticle/894369 ⊙ Center for Infectious Disease Research and Policy, 2018. "Price to Pay: Antibiotic-Resistant Infections Costs $2B a year." http://www.cidrap.umn.edu/news-perspective/2018/03/price-pay-antibiotic-resistant-infections-cost-2-billion-year ⊙ NIH MedlinePlus Magazine, 2018. "The End of Antibiotics?" https://medlineplus.gov/magazine/issues/winter18/articles/winter18pg8-11.html ⊙ Data for % OF Bacterial Infections with Resistance Graph: https://www.healthaffairs.org/doi/abs/10.1377/hlthaff.2017.1153
4. The U.S. is Becoming Less Geographically Mobile	⊙ Graph Data from US Census Bureau CPS Historical Migration/Geographic Mobility Tables. https://www.census.gov/data/tables/time-series/demo/geographic-mobility/historic.html ⊙ Washington Center for Equitable Growth, 2015. "The consequences and causes of declining geographic mobility in the United States." https://equitablegrowth.org/the-consequences-and-causes-of-declining-geographic-mobility-in-the-united-states/ ⊙ Time, 2017. "The Unseen Threat To America: We Don't Leave our Hometowns." http://time.com/4677919/tyler-cowen-book/

	⊙ Governing.com, 2018. "Why are so many people moving out of the Northeast?" https://www.governing.com/topics/urban/gov-migration-northeast-population-trend.html ⊙ Business Insider, 2018. "Here's how each US state's population changed between 2016 and 2017 because of people moving in and out." https://www.businessinsider.com/state-domestic-migration-map-2016-to-2017-2018-1
5. The U.S.'s Changing Cultural Values	⊙ Gallop, 2019. "Americans' Support for Affirmative Action Programs Rises." https://news.gallup.com/poll/247046/americans-support-affirmative-action-programs-rises.aspx ⊙ Gallop, 2019. "Americans as Concerned as Ever About Global Warming." https://news.gallup.com/poll/248027/americans-concerned-ever-global-warming.aspx ⊙ Gallop, 2019. "Record-Low 46% of Women Pleased with Society's Treatment." https://news.gallup.com/poll/246056/record-low-women-pleased-society-treatment.aspx ⊙ Gallop, 2018. "Two in Three Americans Support Same-Sex Marriage." https://news.gallup.com/poll/234866/two-three-americans-support-sex-marriage.aspx
6. Incarceration Nation on the Decline	⊙ Bureau of Justice Statistics, US Department of Justice https://www.bjs.gov/content/pub/pdf/cpus16.pdf ⊙ Pew Research Center https://www.pewresearch.org/fact-tank/2018/05/02/americas-incarceration-rate-is-at-a-two-decade-low/ ⊙ Prison Policy Initiative, 2018 https://www.prisonpolicy.org/blog/2018/06/05/annualchanges/
7. Income and Wealth Gaps Continue to Widen	⊙ Market Watch 2018 https://www.marketwatch.com/story/wealth-inequality-in-the-us-is-almost-as-bad-as-it-was-right-before-the-great-depression-2018-07-19 ⊙ Vox https://www.vox.com/2018/7/29/17627134/income-inequality-chart ⊙ Inequality.org https://inequality.org/facts/wealth-inequality/ ⊙ Urban Institute https://apps.urban.org/features/wealth-inequality-charts/
8. Increasingly Vulnerable but Still Growing Coastal Populations	⊙ Sea Level Rise.Org, 2018. "The Future of Sea Level Rise." https://sealevelrise.org/forecast/ ⊙ Coastline County Population Data: US Census Bureau https://www.census.gov/library/stories/2018/08/coastal-county-population-rises.html ⊙ NOAA, 2013. "National Coastal Population Report: Population Trends from 1970 to 2020." https://aamboceanservice.blob.core.windows.net/oceanservice-prod/facts/coastal-population-report.pdf ⊙ Climate Central, 2017. "These US Cities are Most Vulnerable to Major Coastal Flooding and Sea Level Rise." https://www.climatecentral.org/news/us-cities-most-vulnerable-major-coastal-flooding-sea-level-rise-21748

9. Life Stages Shifting Older and Out of Order	⊙ CDC National Center for Health Statistics, 2017 https://www.cdc.gov/nchs/nvss/births.htm ⊙ US Census, 2018. "Historical Marital Status Tables." https://www.census.gov/data/tables/time-series/demo/families/marital.html ⊙ Zillow, 2015. "Today's First-Time Homebuyers Older, More Often Single." http://zillow.mediaroom.com/2015-08-17-Todays-First-Time-Homebuyers-Older-More-Often-Single ⊙ Gallup, 2018. "Snapshot: Average American Predicts Retirement at Age 66 https://news.gallup.com/poll/234302/snapshot-americas-project-average-retirement-age.aspx ⊙ Institute for Family Studies, 2017. "How We Ended Up with 40 Percent of Children Born out of Wedlock." https://ifstudies.org/blog/how-we-ended-up-with-40-percent-of-children-born-out-of-wedlock
10. Rising Costs of Living are Gentrifying the Nation's Cities	⊙ Governing.com 2018. "The Widening Cost-of-Living Gap." https://www.governing.com/topics/urban/gov-cost-of-living-regions.html ⊙ Forbes, 2018. "These 20 Cities' Cost of Living Rose the Fastest in 2018." https://www.forbes.com/sites/andrewdepietro/2018/10/12/2018-cities-cost-of-living-rising-fastest/#22b6be643d40 ⊙ Expatistan Cost of Living World Map https://www.expatistan.com/cost-of-living/index/north-america ⊙ US Bureau of Labor Statistics. Consumer Price Index. https://www.bls.gov/cpi/
11. Deepening Battle Over Vaccines	⊙ Data for Graphs: CDC Health, United States 2017, Table 66 https://www.cdc.gov/nchs/data/hus/2017/066.pdf ⊙ ProCon.org "Measles, Mumps, and Rubella (German Measles) Cases and Deaths, and MMR Vaccination Rates." https://vaccines.procon.org/view.additional-resource.php?resourceID=005969 ⊙ Forbes, 2019. "The Hidden Reason Behind Low Vaccination Rates in the US." https://www.forbes.com/sites/nicolefisher/2019/01/28/the-hidden-reason-behind-low-vaccination-rates-in-the-u-s/#710174b61527 ⊙ Human Vaccines and Immunotherapeutics. 2016. "Rotavirus vaccination in a Medicaid Infant Population from Four US States: Compliance, Vaccination Completion Rate, and Predictors of Compliance." https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4963051/ BlueCross BlueShield, 2018. "Early Childhood Vaccination Trends in America." https://www.bcbs.com/the-health-of-america/reports/early-childhood-vaccination-trends-america
12. Americans are Becoming Increasingly Diverse	⊙ Pew Research Center, 2015. "Estimated US Population by Race and Hispanic Origin, 1965-2015…" https://www.pewhispanic.org/2015/09/28/modern-immigration-wave-brings-59-million-to-u-s-driving-population-growth-and-change-through-2065/ph_2015-09-28_immigration-through-2065-a2-05/ ⊙ Brookings, 2019. "Less Than Half of US Children Under 15 are White, Census Shows." https://www.brookings.edu/research/less-than-half-of-us-children-under-15-are-white-census-shows/ ⊙ Andrew W. Mellon Foundation, 2016. "the "Diversity Explosion" Is America's Twenty-First-Century Baby Boom." https://mellon.org/initiatives/our-compelling-interests/excerpts/diversity-explosion-americas-twenty-first-century-baby-boom/

	⊙ Brookings, 2018. "The US will Become 'Minority White' in 2045, Census Says." https://www.brookings.edu/blog/the-avenue/2018/03/14/the-us-will-become-minority-white-in-2045-census-projects/ ⊙ US Census, 2018. "Older People Projected to Outnumber Children for First Time in US History." https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html
13. America's Shifting Faith Landscape	⊙ GSS Data Explorer https://gssdataexplorer.norc.org/trends/Religion%20&%20Spirituality?measure=relig_rec ⊙ Pew Research Center. 2015. "America's Changing Religious Landscape." https://www.pewforum.org/2015/05/12/americas-changing-religious-landscape/ ⊙ PRRI.org, 2017. "America's Changing Religious Identity." https://www.prri.org/research/america-religious-landscape-christian-religiously-unaffiliated/ ⊙ Gallup, Religion Polling. 2018. "Religion." https://news.gallup.com/poll/1690/religion.aspx ⊙ Huffpost.com, 2017. "7 Trends that Offer a Snapshot of American Religion Today." https://www.huffpost.com/entry/7-trends-that-offer-a-snapshot-of-american-religion-today_n_59b9a559e4b02da0e13eedbe
14. Ballooning Student Debt	⊙ NBC News, 2019. "These five charts show how bad the student loan debt situation is. https://www.nbcnews.com/news/us-news/student-loan-statistics-2019-n997836 ⊙ Peter G. Peterson Foundation, 2018. "Student Debt Continues to Rise." https://www.pgpf.org/blog/2018/07/the-facts-about-student-debt ⊙ Bloomberg., 2018. "The Student Loan Debt Crisis is About to Get Worse." https://www.bloomberg.com/news/articles/2018-10-17/the-student-loan-debt-crisis-is-about-to-get-worse ⊙ Forbes, 2019. "Student Loan Debt Statistics in 2019: A $1.5 Trillion Crisis." https://www.forbes.com/sites/zackfriedman/2019/02/25/student-loan-debt-statistics-2019/#6e33401d133f ⊙ Data source: Federal Reserve Bank of New York. Quarterly Report on Household Debt and Credit.
15. Runaway Healthcare Spending	⊙ Peterson Center on Healthcare and Henry J. Kaiser Family Foundation. 2019. "US health system is performing better though still lagging behind other countries." https://www.healthsystemtracker.org/brief/u-s-health-system-is-performing-better-though-still-lagging-behind-other-countries/#item-start ⊙ Global Burden of Disease Study 2016. "Healthcare Access and Quality Index Based on Amenable Mortality 1990-2016." http://ghdx.healthdata.org/record/ihme-data/gbd-2016-healthcare-access-and-quality-index-1990-2016 ⊙ World Bank World Development Indicators. Data series on per capita healthcare spending. https://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#

16. Falling Life Expectancy	⊙ Life expectancy data from: Peterson-Kaiser Health System Tracker. 2019. "How Does US Life Expectancy Compare to Other Countries? https://www.healthsystemtracker.org/chart-collection/u-s-life-expectancy-compare-countries/#item-start ⊙ Overdose mortality rate data from: National Institute on Drug Abuse, 2019. "Overdose Death Rates." https://www.drugabuse.gov/related-topics/trends-statistics/overdose-death-rates ⊙ Suicide mortality rate data from: Centers for Disease Control and Prevention, 2018. "Suicide Mortality in the United States, 1999-2017." https://www.cdc.gov/nchs/products/databriefs/db330.htm ⊙ US Burden of Disease Collaborators, 2018. "The State of US Health, 1990-2016: Burden of Diseases, Injuries, and Risk Factors Among US States." https://jamanetwork.com/journals/jama/fullarticle/2678018 ⊙ Popular Science, 2018. "The Decline in US Life Expectancy is Unlike Anything We've Seen in a Century." https://www.popsci.com/life-expectancy-declining
17. Worsening Maternal Mortality in the US	⊙ NPR, 2017. "US has the worst rate of maternal deaths in the developed world." https://www.npr.org/2017/05/12/528098789/u-s-has-the-worst-rate-of-maternal-deaths-in-the-developed-world ⊙ Global Burden of Disease Study, 2016. "Global, regional, and national levels of maternal mortality, 1990—2015: a systematic analysis for the Global Burden of Disease Study." https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(16)31470-2.pdf ⊙ USA Today, 2018. "Which States have the Worst Maternal Mortality?" https://www.usatoday.com/list/news/investigations/maternal-mortality-by-state/7b6a2a48-0b79-40c2-a44d-8111879a8336/?block=hawaii ⊙ National Geographic, 2018. "American Women are Still Dying at Alarming Rates while Giving Birth." https://www.nationalgeographic.com/culture/2018/12/maternal-mortality-usa-health-motherhood/
18. Unequal Burden of Disease	⊙ Data for Prevalence by Total Population: CDC's Division of Diabetes Translation. https://www.cdc.gov/diabetes/statistics/slides/long_term_trends.pdf ⊙ Data for Prevalence by Ethnicity: Peterson-Kaiser Health System Tracker. https://www.healthsystemtracker.org/chart/blacks-hispanics-higher-average-rates-diagnosed-diabetes/#item-start ⊙ Los Angeles Times, 2017. "Type 2 Diabetes, Once Considered a Disease for Adults, is Increasingly Common in Tweens and Teens." https://www.latimes.com/science/sciencenow/la-sci-sn-diabetes-youth-rising-20170413-htmlstory.html ⊙ Data for State by State Prevalence: The State of Obesity.org: "Diabetes in the United States." https://www.stateofobesity.org/diabetes/
19. Growing Mental Health Crisis	⊙ Data for graph from: CDC, 2018. "Suicide Mortality in the United States, 1999-2017." https://www.cdc.gov/nchs/products/databriefs/db330.htm ⊙ BBC News, 2018. "Why US suicide rate is on the rise." https://www.bbc.com/news/world-us-canada-44416727 ⊙ Vox, 2018. "Suicides are at the highest rate in decades, CDC report shows.

	https://www.vox.com/science-and-health/2018/11/29/18118601/suicide-rate-highest-decades-life-expectancy ⊙ Columbia University School of Public Health, 2017. "Depression is on the rise in the US, especially among young teens." https://www.mailman.columbia.edu/public-health-now/news/depression-rise-us-especially-among-young-teens
20. Medical/Health Innovation Accelerating	⊙ Vinod Bakthavachalam, 2018. "Medical Innovation and Reform in the US." https://medium.com/vinod-b/medical-innovation-and-reform-in-the-us-b2a13f88a05f ⊙ Patent data series from: World Intellectual Property Organization https://www.wipo.int/ipstats/en/ ⊙ Genome Sequencing Data from: National Human Genome Research Institute Genome Sequencing Program https://www.genome.gov/sequencingcostsdata/ ⊙ Our World In Data. "Technical Progress." https://ourworldindata.org/technological-progress
21. Healthcare Becoming Increasingly Digital and Distributed	⊙ McKinsey, 2018 https://healthcare.mckinsey.com/future-healthcare-finding-opportunities-lie-beneath-uncertainty ⊙ Nesta.org, 2018 https://www.nesta.org.uk/feature/10-predictions-2018/tech-giants-race-to-buy-a-healthcare-provider/ ⊙ McKinsey, 2018 https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/the-silent-shapers-of-healthcare-services ⊙ PwC, 2018 https://www.pwc.com/us/en/health-industries/health-research-institute/pdf/pwc-hri-the-new-health-economy-in-the-age-of-disruption.pdf ⊙ Institute for the Future, 2014 http://www.iftf.org/uploads/media/IFTFforVitalityInstitute_TechCatalystsMap_01.pdf
22. Expanding Health Deserts and the Urban/Rural Divide	⊙ Data for graph: US GAO, 2018. "Rural Hospital Closures: Number and Characteristics of Affected Hospitals and Contributing Factors." https://www.gao.gov/assets/700/694125.pdf ⊙ Association of America Medical Colleges, 2017. "Health Disparities Affect Millions in Rural US Communities." https://news.aamc.org/patient-care/article/health-disparities-affect-millions-rural-us-commun/ ⊙ TheDO.Osteopathioc.org, 2018. "Rural Hospital Closures Increased Dramatically in the Past 5 Years." https://thedo.osteopathic.org/2018/10/rural-hospital-closures-increased-dramatically-in-the-past-5-years/

Appendix B: Emerging Issues Supporting Scan Hits

Emerging Issue	Supporting Scan Hits
1. The New Job Market	⊙ The Future of Work The Rise of the Gig Economy https://www.naco.org/featured-resources/future-work-rise-gig-economy ⊙ How The Gig Economy Is Reshaping Careers For The Next Generation https://www.forbes.com/sites/johnfrazer1/2019/02/15/how-the-gig-economy-is-reshaping-careers-for-the-next-generation/#39e8f10449ad ⊙ The gig economy is quietly undermining a century of worker protections https://qz.com/1556194/the-gig-economy-is-quietly-undermining-a-century-of-worker-protections/ ⊙ Employee Benefits of the Gig Economy https://www.griffinbenefits.com/employeebenefitsblog/employee-benefits-in-the-gig-economy ⊙ This State Wants to Offer Universal Benefits to Gig Workers http://fortune.com/2017/10/13/gig-economy-workers-benefits/ ⊙ Do Unions Have A Place In The Gig Economy? https://www.fisherphillips.com/gig-employer/do-unions-have-a-place-in-the ⊙ What Does A Union Look Like In The Gig Economy? https://www.fastcompany.com/3042081/what-does-a-union-look-like-in-the-gig-economy
2. It takes a Village	⊙ Me, myself and my Twenty Roommates: Why Communal Living is the Future https://www.zipcar.com/ziptopia/city-living/why-communal-living-is-the-future ⊙ Communal Living, Barter Systems, Shared Energy: What Will Future Communities Look Like? https://edgy.app/communal-living-future-communities ⊙ Communal living projects moving from hippie to mainstream https://www.theguardian.com/sustainable-business/2015/may/11/communal-living-projects-moving-from-hippie-to-mainstream ⊙ Communal living: the future for families? https://www.telegraph.co.uk/women/womens-life/10769817/Communal-living-the-future-for-families.html ⊙ Here are five lessons on the future of co-living https://www.citymetric.com/fabric/here-are-five-lessons-future-co-living-3792 ⊙ 70% of people globally work remotely at least once a week, study says https://www.cnbc.com/2018/05/30/70-percent-of-people-globally-work-remotely-at-least-once-a-week-iwg-study.html ⊙ Common https://www.common.com/ ⊙ WeLive https://www.welive.com/
3. Mainstream Health Foods with Consequences	⊙ Hope Alkon, Alison; Mares, Teresa Marie (2012, September) *Food sovereignty in US food movements: radical visions and neoliberal constraints* https://link.springer.com/article/10.1007/s10460-012-9356-z ⊙ Mandes, Trisha (2013, May 8) *Does Food Sovereignty Exist in the United States? Food and the Community Rights Movement* http://readthedirt.org/does-food-sovereignty-exist-in-the-united-states-food-and-the-community-rights-movement ⊙ Burns, Janet (2015, February 6) *How Urban Farming Could Change Hawaii*

		https://www.citylab.com/life/2015/02/how-urban-farming-could-change-hawaii/385178/ ⊙ Peretti, Jacques (2013, August 7) *Far profits: how the food industry cashed in on obesity* https://www.theguardian.com/lifeandstyle/2013/aug/07/fat-profits-food-industry-obesity ⊙ Levin, Jennifer (2018, November 23) *Book Review: "Hippie Food: How Back-to-the-Landers, Longhairs, and Revolutionaries Changed the Way We Eat" by Jonathan Kauffman* http://www.santafenewmexican.com/pasatiempo/books/hippie-food-how-back-to-the-landers-longhairs-and-revolutionaries/article_3bdbc15e-07ce-5421-a1d1-84797456d0c4.html ⊙ Friedersdorf, Conor (2014, September 3) *How Urban Farming Is Making San Francisco's Housing Crisis Worse* https://www.theatlantic.com/business/archive/2014/09/how-urban-farming-is-making-san-franciscos-housing-crisis-worse/379438/ ⊙ Hussain, Azhar; Syed, Ali; Madiha Ahmed, and Sheharyar, Hussain (July 2018) *The Anti-vaccination Movement: A Regression in Modern Medicine* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6122668/ ⊙ Sharman, Jon (2017, September 16) *Global health chief warns 'Whole Foods mums' over MMR vaccine* https://www.independent.co.uk/news/health/mmr-vaccine-rates-whole-foods-mums-warning-seth-berkley-gavi-a7950281.html ⊙ Redman, Russell (2018, August 29) *Amazon, Wholefoods extend Prime Now Delivery* https://www.supermarketnews.com/online-retail/amazon-whole-foods-extend-prime-now-delivery ⊙ Emiliya, A (2017, December 15) Iowa Farmer Is Selling Micro-Cows the Size of Large Dogs as Pets https://www.odditycentral.com/animals/iowa-farmer-is-selling-micro-cows-the-size-of-large-dogs-as-pets.html ⊙ Nichols, Grey (2019, January 24) *Delivery wars: Amazon's new delivery robot vs Starship's college munchie robot* *https://www.zdnet.com/article/amazons-new-delivery-robot-vs-starships-college-munchie-robot/*
4.	Marijuana Freedom	⊙ Racial Inequality https://endhomelessness.org/homelessness-in-america/what-causes-homelessness/inequality/ ⊙ Pot Legalization Is Transforming California's Criminal Justice Landscape. Here's How. https://www.motherjones.com/crime-justice/2017/12/pot-legalization-is-transforming-californias-criminal-justice-landscape-heres-how/ ⊙ Legal Marijuana Made Big Promises on Racial Equality - and Fell Short https://www.nbcnews.com/news/nbcblk/legal-marijuana-made-big-promises-racial-equity-fell-short-n952376 ⊙ Oakland reserves marijuana biz permits for people who served time for weed https://www.thecannabist.co/2017/03/09/oakland-marijuana-business-permits-convictions/75252/ ⊙ Senator Files '420' Marijuana Bill To Legalize It Federally https://www.forbes.com/sites/tomangell/2019/02/08/feds-would-tax-marijuana-under-new-senate-bill-actually-numbered-s-420/#51ff85d8612f ⊙ Where the 2020 presidential candidates stand on marijuana legalization https://mashable.com/article/marijuana-legalization-election-2020/?europe=true ⊙ Marijuana is illegal under federal law even in states that legalize it https://www.vox.com/identities/2018/8/20/17938372/marijuana-legalization-federal-prohibition-drug-scheduling-system

		⊙ Cannabis Legalization and the Quest for Social and Economic Justice https://www.greenentrepreneur.com/article/324878 ⊙ New marijuana laws in 2019 could help black and Latino drug dealers go legal https://eu.usatoday.com/story/news/2019/02/21/marijuana-legalization-2019-black-latino-dealers-now-getting-help/2838959002/ ⊙ Why marijuana legalization is an equality issue https://www.theguardian.com/public-leaders-network/2015/jan/21/legalization-marijuana-us-states-inclusive-growth ⊙ Former Physician At Rikers Island Exposes Health Risks Of Incarceration https://www.npr.org/sections/health-shots/2019/03/18/704424675/former-physician-at-rikers-island-exposes-health-risks-of-incarceration?utm_medium=RSS&utm_campaign=shotshealthnews
5.	Mobilizing Menstrual Equity	⊙ Periods, Poverty, and the Need for Policy: A Report on Menstrual Inequity in the United States https://cdn.ymaws.com/www.law.udc.edu/resource/resmgr/LegClinic/2018_periods_policy_report.pdf ⊙ Period poverty: call to tackle the hidden side of inequality https://www.theguardian.com/society/2016/dec/12/period-poverty-call-to-tackle-the-hidden-side-of-inequality ⊙ Republican or Democrat – We can all agree on axing the tampon tax https://www.newsweek.com/tampon-tax-republican-democrat-opinion-1391763 ⊙ Period poverty is a thing, even in the U.S. https://www.forbes.com/sites/berenicemagistretti/2019/01/25/fembeat-period-poverty-is-a-thing-even-in-the-u-s/#6267c959569e ⊙ Getting your period is still oppressive in the United States https://www.harpersbazaar.com/culture/features/a10235656/menstrual-period-united-states/ ⊙ Nevada becomes the 10th state to eliminate a 'pink tax' on menstrual products https://www.cnn.com/2018/11/07/health/nevada-tampon-tax-repealed-trnd/index.html ⊙ Could menstrual cups be the answer to period poverty? https://rightsinfo.org/menstrual-cups-answer-period-poverty/ ⊙ Menstrual Cup Companies that Give Back https://putacupinit.com/charity/
6.	Automated Transport Networks	⊙ Self-driving Cars In 10 Years: EU Expects 'Fully Automated' Cars by 2030 https://www.forbes.com/sites/johnkoetsier/2019/04/06/self-driving-cars-in-10-years-eu-expects-fully-automated-cars-by-2030/#2ffb704e615b ⊙ Self-Driving Cars Explained https://www.ucsusa.org/clean-vehicles/how-self-driving-cars-work ⊙ Emergency Department Visits for Motor Vehicle Traffic Injuries: United States, 2010-2011 https://www.cdc.gov/nchs/data/databriefs/db185.htm

7.	Climate Crisis Impacts Health of Most Vulnerable	⊙ Psychosis in teens may be linked to an unlikely culprit: air pollution https://www.cnn.com/2019/03/27/health/air-pollution-teen-psychosis-study/index.html?no-st=1555612175 ⊙ Tropical disease to ride mosquitos really far north https://www.futurity.org/mosquito-borne-diseases-climate-change-2021572-2/ ⊙ Allergy season is getting worse thanks to climate change https://www.forbes.com/sites/stevensalzberg/2019/04/15/allergy-season-is-getting-worse-thanks-to-climate-change/#42a95b665a9f ⊙ In Florida, doctors see climate change hurting their most vulnerable patients https://www.npr.org/2019/03/30/706941118/in-florida-doctors-see-climate-change-hurting-their-most-vulnerable-patients?utm_medium=RSS&utm_campaign=storiesfromnpr ⊙ Enviromedics: The Impact of Climate Change on Human Health https://ebookcentral.proquest.com/lib/uhm/reader.action?docID=5059903&ppg=20 ⊙ Climate change in the US will hurt poor people the most, according to a bombshell federal report https://www.cnbc.com/2018/11/26/climate-change-will-hurt-poor-people-the-most-federal-report.html ⊙ Climate Change Has Already Increased Global Inequality. It Will Only Get Worse http://time.com/5575523/climate-change-inequality/ ⊙ Insurance experts rank climate change as top risk for 2019 https://grist.org/article/insurance-experts-rank-climate-change-as-top-risk-for-2019/ ⊙ While the rich world braces for future climate change, the poor world is already being devastated by it https://www.cnn.com/2019/03/31/africa/poorest-hit-the-hardest-climate-change-mozambique-intl/index.html ⊙ How climate change is adding to the health risks of poor people https://www.greenbiz.com/article/how-climate-change-adding-health-risks-poor-people
8.	US Economic Recession*	⊙ America's longest-ever expansion will approach its end in 2019 https://www.economist.com/the-world-in/2018/12/27/americas-longest-ever-expansion-will-approach-its-end-in-2019 ⊙ U.S. Economy Will Slow in 2019, May Enter Recession in 2020, Economists Forecast. Trump Administration Disagrees http://fortune.com/2018/11/21/us-economy-slow-2019-recession-2020-economist-forecast/ ⊙ U.S. Recession Chances in Next Two Years Top 60%, JPMorgan Says https://www.bloomberg.com/news/articles/2018-10-18/u-s-recession-chances-in-next-two-years-top-60-jpmorgan-says ⊙ Will The Economy Crash In 2019? https://www.forbes.com/sites/billconerly/2018/10/14/will-the-economy-crash-in-2019/#1d376caf7606 ⊙ The economy is humming. So why do experts foresee a recession in 2020? https://www.usatoday.com/story/money/2018/06/11/recession-2020-heres-why-economists-think-may-happen/686177002/

9. Sugar is the New Tobacco	⊙ CDC: Leading causes of death and numbers of deaths, by sex, race, and Hispanic origin: United States, 1980 and 2016 https://www.cdc.gov/nchs/data/hus/2017/019.pdf ⊙ Food Serving Sizes Get a Reality Check http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm386203.htm ⊙ Hunger & Poverty in America - Food Research & Action Center http://frac.org/hunger-poverty-america ⊙ Why the Western Diet Keeps Making Us Sick https://www.everydayhealth.com/crohns-disease/diet/why-western-diet-making-us-sick/ ⊙ Keto may be the next 'fad' diet but is it healthy? https://www.foodnavigator.com/Article/2018/08/21/Keto-may-be-the-next-fad-diet-but-is-it-healthy ⊙ Fat profits: how the food industry cashed in on obesity http://www.theguardian.com/lifeandstyle/2013/aug/07/fat-profits-food-industry-obesity ⊙ 5 Reasons You Should Avoid High Fructose Corn Syrup at All Costs https://www.onegreenplanet.org/natural-health/reasons-you-should-avoid-high-fructose-corn-syrup-at-all-costs/ ⊙ 6 Foods That Cause Inflammation https://www.healthline.com/nutrition/6-foods-that-cause-inflammation ⊙ 8 Surprising Things That Harm Your Gut Bacteria https://www.healthline.com/nutrition/8-things-that-harm-gut-bacteria ⊙ Behavioral Therapy for Obesity: What It Is, How It Works http://www.berkeleywellness.com/healthy-eating/diet-weight-loss/article/treating-obesity-behavioral-therapy ⊙ Current Eating Patterns in the United States - 2015-2020 Dietary Guidelines https://health.gov/dietaryguidelines/2015/guidelines/chapter-2/current-eating-patterns-in-the-united-states/ ⊙ Top 10 sources of calories in the U.S. diet - Harvard Health https://www.health.harvard.edu/healthy-eating/top-10-sources-of-calories-in-the-us-diet
10. Digital Alienation	⊙ Banking's Forgotten Generation? https://thefinancialbrand.com/61062/baby-boomer-banking-segmentation/ ⊙ People Are Reportedly Attacking Driverless Cars in California https://futurism.com/people-attacking-driverless-cars-california/ ⊙ Artificial Intelligence, the pros, the cons and what to really fear http://www.defenseone.com/feature/artificial-intelligence-pro-con/?oref=WA ⊙ The dark side of the sharing economy https://www.weforum.org/agenda/2018/01/the-dark-side-of-the-sharing-economy/ ⊙ The Real Sharing Economy http://www.futureagenda.org/insight/the-real-sharing-economy ⊙ Worker owned coops are coming for the gig economy https://www.fastcompany.com/40575728/worker-owned-co-ops-are-coming-for-the-digital-gig-economy ⊙ The Uneven Future of Urbanization https://www.citylab.com/equity/2012/04/uneven-future-urbanization/1707/ ⊙ "Sorry, I've only got my card" Can homeless adapt to the cashless society? https://www.theguardian.com/cities/2018/feb/27/card-cashless-society-homeless-contactless-payments-britain ⊙ Successful Aging, feeling left out of the digital future https://www.dailynews.com/2018/02/14/successful-aging-10/

11. Male Birth Control Pill	⊙ A New Male Birth Control Pill is Being Tested. Here's What to Know http://time.com/5556193/male-birth-control-pill/ ⊙ Male Birth Control on the Horizon: A Man's View http://www.ashasexualhealth.org/male-birth-control-on-the-horizon-a-mans-view/ ⊙ Male Birth Control Pill Passes Human Safety Tests https://www.technologynetworks.com/drug-discovery/news/male-birth-control-pill-passes-human-safety-tests-317223 ⊙ Pro-Life, Pro-Woman rally says Alabama abortion law 'beginning of the end' https://www.al.com/business/2019/05/pro-life-pro-woman-rally-says-alabama-abortion-law-beginning-of-the-end.html ⊙ Trump, Republicans distance themselves from Alabama abortion law https://www.washingtonpost.com/national/health-science/trump-republicans-distance-themselves-from-alabama-abortion-law/2019/05/19/d44036d8-7a3f-11e9-8bb7-0fc796cf2ec0_story.html?noredirect=on&utm_term=.b8c45faea0d5 ⊙ Poll: Most Americans disapprove of the Alabama abortion ban https://www.vox.com/2019/5/22/18635563/poll-alabama-abortion-ban-law-democrats-republicans-2020 ⊙ Daddy's home: 'Why on earth did I take shared parental leave?' https://www.theguardian.com/lifeandstyle/2016/mar/27/shared-parental-leave-johnny-davis
12. Increasingly Extreme US Political Swings	⊙ Is Congress Rigged in Favor of the Rich https://www.economist.com/graphic-detail/2019/07/22/is-congress-rigged-in-favour-of-the-rich ⊙ Party Division https://www.senate.gov/history/partydiv.htm ⊙ First Up if Democrats Win: Campaign and Ethics Changes, Infrastructure and Drug Prices https://www.nytimes.com/2018/10/31/us/politics/democrats-midterm-elections.html ⊙ US extends foreign aid ban for NGOs supporting abortion https://www.dw.com/en/us-extends-foreign-aid-ban-for-ngos-supporting-abortion/a-48068966 ⊙ Republican Lawmakers Brace For Impact Of Renewed Push To Repeal Obamacare https://www.npr.org/2019/03/27/707183175/republican-lawmakers-brace-for-impact-of-renewed-push-to-repeal-obamacare ⊙ The repeal of the 'Cadillac tax' showed a hazard of bipartisanship https://www.thenewsstar.com/story/opinion/columnists/2019/07/31/repeal-cadillac-tax-showed-hazard-bipartisanship/1866274001/
13. Collapse of a Generation	⊙ Behold the Millennial Nuns https://www.huffpost.com/highline/article/millennial-nuns/?guccounter=1&guce_referrer=aHR0cHM6Ly9ncm91cHMuZGlpZ28uY29tL2dyb3VwL3JpcHBlbA&guce_referrer_sig=AQAAALvdgLkubQEtfm6mmDEBbT6KLYSwwXkg6-ToFL-FuD9lB-Fqag3k9PO1eKKw3ZiQQd8SKYz8WaZDH-zH2uatjnPy_iSbImEvrcXsCpDt7kDGfDnEhqb69Q4qesEkWKsKSlgwfTpXIXml-2XTziWibsPeQ3LgUAP6yT-sBMApFZg9 ⊙ College grads expect to pay off student debt in 6 years—this is how long it will actually take

	https://www.cnbc.com/2019/05/23/cengage-how-long-it-takes-college-grads-to-pay-off-student-debt.html ⊙ Mental health issues increased significantly in young adults over last decade https://www.sciencedaily.com/releases/2019/03/190315110908.htm ⊙ Amid Opioid Crisis, Walgreens Adds Mental Health Training For Pharmacists https://www.forbes.com/sites/brucejapsen/2019/05/01/amid-opioid-crisis-walgreens-adds-mental-health-training-for-pharmacists/#40aff9ba7b68 ⊙ Barbers Receive Mental Health Training With Hopes of Reducing Male Suicide Rate http://www.femestella.com/barber-mental-health-male-suicide/ ⊙ Mental health added to impact of climate change as global damage grows https://www.smh.com.au/environment/climate-change/mental-health-added-to-impact-of-climate-change-as-global-damage-grows-20181129-p50j2d.html ⊙ Is an Increase in Individualism Damaging Our Mental Health? https://www.psychologytoday.com/us/blog/talking-about-men/201707/is-increase-in-individualism-damaging-our-mental-health ⊙ Performance-based pay linked to employee mental-health problems, study shows https://source.wustl.edu/2019/03/performance-based-pay-linked-to-employee-mental-health-problems-study-shows/
14. Birthstrike	⊙ U.S. Births Fell To A 32-Year Low In 2018; CDC Says Birthrate Is In Record Slump https://www.npr.org/2019/05/15/723518379/u-s-births-fell-to-a-32-year-low-in-2018-cdc-says-birthrate-is-at-record-level ⊙ Why the US birthrate hitting a 32-year low could become a big problem https://www.usatoday.com/story/news/health/2019/05/15/birth-rate-united-states-hits-32-year-low-2018-cdc-says/3676733002/ ⊙ Living for longer, Singaporeans can offset low birth rate by continuing to work https://www.straitstimes.com/world/europe/living-for-longer-singaporeans-can-offset-low-birth-rate-by-continuing-to-work-amy-khor ⊙ Future demand for elderly care services like assisted living & in-home care are rife for digital disruption https://www.businessinsider.com/senior-care-market-trends
15. A New End of Life	⊙ Washington passes bill to become first state to compost human bodies https://www.washingtonpost.com/science/2019/04/26/washington-passes-bill-become-first-state-compost-human-bodies/?utm_source=reddit.com&utm_term=.851b3c0cd93b ⊙ Invest in the future of deathcare https://www.recompose.life/invest ⊙ How to be eco-friendly when you're dead https://www.theatlantic.com/technology/archive/2014/10/how-to-be-eco-friendly-when-youre-dead/382120/ ⊙ Racial, cultural, and ethnic factors influencing end-of-life care https://www.ncbi.nlm.nih.gov/pubmed/16499470 ⊙ Euthanasia's economics https://www.catholicweekly.com.au/branka-van-der-linden-euthanasias-economics/ ⊙ In 10 years, half of middle-income elders won't be able to afford housing and medical care https://khn.org/news/in-10-years-half-of-middle-income-elders-wont-be-able-to-afford-housing-medical-care/
16. Techno Holistic Healthcare	⊙ 8 Smart Uses for Your Smartphone https://www.nm.org/healthbeat/healthy-tips/how-smartphones-support-health

		⊙ How your smartphone can look after your health https://home.bt.com/tech-gadgets/phones-tablets/smartphone-apps-well-being-health-11364077472010 ⊙ Wearable and App Users Tracking Health Tech's Next Step https://morningconsult.com/2019/01/08/wearable-and-app-users-tracking-health-techs-next-step/ ⊙ A 'smart' toilet could stop us from flushing away our most valuable health information, argues this doctor https://www.cnbc.com/2018/11/21/smart-toilets-would-be-a-huge-boon-to-public-health-commentary.html ⊙ The 7 Most Exciting Fitness Tech Innovations From CES 2018 https://www.self.com/story/fitness-tech-innovations-from-ces-2018 ⊙ 8 consumer-friendly digital tools to support behavioral health https://www.mobihealthnews.com/content/8-consumer-friendly-digital-tools-support-behavioral-health
17.	Automation Driving Macroeconomic Reform	⊙ Schiller, Ben (2018, February 21) *How Demographics, Automation, And Inequality Will Shape The Next Decade* https://www.fastcompany.com/40531968/how-demographics-automation-and-inequality-will-shape-the-next-decade ⊙ Yan, Nicholas (2016, October 2) *Automated Inequality* http://harvardpolitics.com/world/automation/ ⊙ Ramaswamy, Sree; Madgavkar, Anu (2018, March) *What will automation mean for wages and income inequality?* https://www.mckinsey.com/featured-insights/future-of-work/what-will-automation-mean-for-wages-and-income-inequality ⊙ Harris, Karen, Kimson, Austin and Schwedel, Andrew (2018, March 13) *Why the Automation Boom Could Be Followed by a Bust* https://hbr.org/2018/03/why-the-automation-boom-could-be-followed-by-a-bust ⊙ Allen, Tom (2018, July 2) *Automation will increase the economic wealth gap* https://www.computing.co.uk/ctg/news/3035136/automation-will-increase-the-economic-wealth-gap ⊙ Hemous, David and Olsen, Morten (2015) *The Rise of the Machines: Automation, Horizontal Innovation and Income Inequality* https://ideas.repec.org/p/red/sed014/162.html ⊙ Amadeo, Kimberly (2018, November 7) *Income Inequality in America* https://www.thebalance.com/income-inequality-in-the U.S.-3306190 ⊙ Paul, Kari (2018, August 5) *America's 1% hasn't controlled this much wealth since before the Great Depression https://www.marketwatch.com/story/wealth-inequality-in-the-us-is-almost-as-bad-as-it-was-right-before-the-great-depression-2018-07-19* ⊙ Inequality.org (2018) *Facts Wealth inequality in the United States https://inequality.org/facts/wealth-inequality/* ⊙ Flowers, Andrew (2018, April 2) *What would happen if we just gave people money?* https://fivethirtyeight.com/features/universal-basic-income/ ⊙ Dubner, Stephen (2016, April 13) *Is the World Ready for a Guaranteed Basic Income? http://freakonomics.com/podcast/mincome/*
18.	Diets as Medicine and Social/ Ecological Justice	⊙ Warming: Plants are also stressed out https://www.sciencedaily.com/releases/2019/04/190419103708.htm ⊙ The Coming Obsolescence of Animal Meat https://www.theatlantic.com/health/archive/2019/04/just-finless-foods-lab-grown-meat/587227/?utm_source=feed

	⊙ Would You Change Your Eating Habits to Reduce Your Carbon Footprint? https://www.nytimes.com/2019/05/02/learning/would-you-change-your-eating-habits-to-reduce-your-carbon-footprint.html ⊙ From Apples to Popcorn, Climate Change Is Altering the Foods America Grows https://www.nytimes.com/2019/04/30/dining/farming-climate-change.html?module=inline ⊙ The Climate-Friendly Vegetable You Ought to Eat https://www.nytimes.com/2019/04/30/dining/kelp-seaweed-recipes.html?module=inline ⊙ These Five Cuisines Are Easier on the Planet https://www.nytimes.com/2019/04/30/climate/these-five-cuisines-are-easier-on-the-planet.html?module=inline ⊙ White Americans' diets are particularly bad for the planet https://www.popsci.com/diets-sociology-climate-change?dom=rss-default&src=syn ⊙ You probably need more vitamins, but pills won't cut it https://www.popsci.com/vitamins-supplements-food-health-benefits?dom=rss-default&src=syn ⊙ Bad Diets Are Responsible For More Deaths Than Smoking, Global Study Finds https://www.npr.org/sections/thesalt/2019/04/03/709507504/bad-diets-are-responsible-for-more-deaths-than-smoking-global-study-finds?utm_medium=RSS&utm_campaign=storiesfromnpr ⊙ In the Future, Everything Will Be Made of Chickpeas https://www.theatlantic.com/health/archive/2019/03/chickpea-products-have-exploded-popularity-us/584956/?utm_source=feed ⊙ Prescribing healthy food in Medicare/Medicaid is cost effective, could improve health https://www.sciencedaily.com/releases/2019/03/190319163532.htm ⊙ Racial Inequity in the Food System https://www.youngfarmers.org/2019/02/racial-inequity/
19. Elder Exploitation	⊙ In 10 years, half of middle-income elders won't be able to afford housing and medical care https://khn.org/news/in-10-years-half-of-middle-income-elders-wont-be-able-to-afford-housing-medical-care/ ⊙ Retirement in America: Out of Reach for Working Americans? https://www.nirsonline.org/wp-content/uploads/2018/09/FINAL-Report-.pdf ⊙ Seniors and the Gig Economy https://www.aginginplace.org/seniors-and-the-gig-economy/ ⊙ The gig economy is quietly undermining a century of worker protections https://qz.com/1556194/the-gig-economy-is-quietly-undermining-a-century-of-worker-protections/ ⊙ Safety and Health at the Heart of the Future of Work https://www.ilo.org/safework/events/safeday/WCMS_686645/lang--en/index.htm ⊙ The State of America Retirement https://www.epi.org/publication/retirement-in-america/ ⊙ This is what life without retirement savings looks like https://www.theatlantic.com/business/archive/2018/02/pensions-safety-net-california/553970/ ⊙ Social Security Programs and Elderly Employment in Japan https://www.nber.org/papers/w25243 ⊙ Why some Japanese pensioners want to go to jail

	https://www.bbc.com/news/stories-47033704 ⊙ In aging Singapore, some elderly head back to work https://twitter.com/Reuters/status/1092594405733789698
20. Solving Waste Inequity	⊙ New Technologies Could Revolutionize Waste Cleanup & Disposal https://emagazine.com/new-waste-technologies/ ⊙ 'We're not a dump': Poor Alabama towns struggle under the stench of toxic landfills https://grist.org/article/were-not-a-dump-poor-alabama-towns-struggle-under-the-stench-of-toxic-landfills/ ⊙ The Lawyer Who Became DuPont's Worst Nightmare https://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html ⊙ Mathy Stanislaus on what it would take to make waste a climate issue https://www.wastedive.com/news/mathy-stanislaus-circular-economy-china/531131/ ⊙ Recycling isn't about the planet. It's about profit. americans-commodities-china.html ⊙ 6 key questions for the waste and recycling industry in 2019 https://www.wastedive.com/news/6-key-questions-for-the-waste-and-recycling-industry-in-2019/545042/ ⊙ China's ban on imported recyclables is drowning U.S. cities in trash http://fortune.com/2019/03/20/china-plastic-pollution-recycling-import-ban-national-sword/ ⊙ How our clothing poisons the environment https://thewalrus.ca/how-our-clothing-poisons-the-environment/ ⊙ Study shows potential for Earth-friendly plastic replacement https://news.osu.edu/study-shows-potential-for-earth-friendly-plastic-replacement/
21. Personalized Medicine	⊙ 8 Smart Uses for Your Smartphone https://www.nm.org/healthbeat/healthy-tips/how-smartphones-support-health ⊙ How your smartphone can look after your health https://home.bt.com/tech-gadgets/phones-tablets/smartphone-apps-well-being-health- 11364077472010 ⊙ Weable and App Users Tracking Health Tech's Next Step https://morningconsult.com/2019/01/08/wearable-and-app-users-tracking-health-techs-next-step/ ⊙ Ancestry and Disease in the Age of Genomic Medicine https://www.nejm.org/doi/full/10.1056/NEJMra0911564 ⊙ Genesight https://www.Genesight.com ⊙ DNA-Based Personalized Medicine May Change Healthcare Forever - Shape Magazine | Shape https://www.shape.com/lifestyle/mind-and-body/dna-based-personalized-medicine-may-change-healthcare-forever ⊙ Drug-Gene Testing http://mayoresearch.mayo.edu/center-for-individualized-medicine/drug-gene-testing.asp
22. End of Personal Privacy	⊙ Third-Party Vendors Behind 20% of Healthcare Data Breaches in 2018 https://healthitsecurity.com/news/third-party-vendors-behind-20-of-healthcare-data-breaches-in-2018

	⊙ We aren't prepared for the next wave of cybersecurity risks https://thehill.com/opinion/cybersecurity/437739-we-arent-prepared-for-the-next-wave-of-cybersecurity-risks ⊙ Chinese people don't care about privacy on the internet — here's why, according to a top professor in China https://www.businessinsider.com/why-china-chinese-people-dont-care-about-privacy-2018-6 ⊙ China's influence on digital privacy could be global https://www.washingtonpost.com/news/theworldpost/wp/2018/08/07/china-privacy/?noredirect=on&utm_term=.1f03d3e9f85f ⊙ U.S. cell carriers are probably still selling your real-time phone location data https://www.fastcompany.com/90290157/u-s-cell-carriers-are-probably-still-selling-your-real-time-phone-location-data ⊙ The 10 Biggest Revelations From Edward Snowden's Leaks https://mashable.com/2014/06/05/edward-snowden-revelations/ ⊙ Americans' complicated feelings about social media in an era of privacy concerns https://www.pewresearch.org/fact-tank/2018/03/27/americans-complicated-feelings-about-social-media-in-an-era-of-privacy-concerns/ ⊙ Cybercrime Damages $6 Trillion By 2021 https://cybersecurityventures.com/hackerpocalypse-cybercrime-report-2016/ ⊙ Chinese Social Credit Score: Utopian Big Data Bliss Or Black Mirror On Steroids? https://www.forbes.com/sites/bernardmarr/2019/01/21/chinese-social-credit-score-utopian-big-data-bliss-or-black-mirror-on-steroids/#153605948b83 ⊙ The great firewall of China: Xi Jinping's internet shutdown https://www.theguardian.com/news/2018/jun/29/the-great-firewall-of-china-xi-jinpings-internet-shutdown
23. Turn Back to One Another: Rising Value of Care Work	⊙ Workers Displaced by Automation should try a new job: Caregiver https://www.wired.com/story/workers-displaced-by-automation-should-try-a-new-job-caregiver/ ⊙ Automation threatening 25% of jobs in the US, especially the 'boring and repetitive' ones: Brookings study https://www.cnbc.com/2019/01/25/these-workers-face-the-highest-risk-of-losing-their-jobs-to-automation.html ⊙ How Demographics, Automation, And Inequality Will Shape The Next Decade https://www.fastcompany.com/40531968/how-demographics-automation-and-inequality-will-shape-the-next-decade ⊙ What will automation mean for wages and income inequality? https://www.mckinsey.com/featured-insights/future-of-work/what-will-automation-mean-for-wages-and-income-inequality ⊙ Economic inequality and public demand for redistribution: combining cross-sectional and longitudinal evidence https://academic.oup.com/ser/article/14/1/119/2363019
24. Climate Refugees and Adaptation	⊙ Cool U.S. cities prepare as future 'havens' for climate migrants https://www.reuters.com/article/us-usa-climatechange-migration/cool-u-s-cities-prepare-as-future-havens-for-climate-migrants-idUSKCN1RI061 ⊙ Climate Adaptation Shouldn't Fuel Inequitable Displacement https://www.nrdc.org/experts/clare-morganelli/climate-adaptation-shouldnt-fuel-inequitable-displacement ⊙ Reimagining Cities in the Face of Climate Change and Migration

	https://www.archdaily.com/903364/how-architects-are-reimagining-cities-in-the-face-of-climate-change-and-migration ⊙ Want to Escape Global Warming? These Cities Promise Cool Relief https://www.nytimes.com/2019/04/15/climate/climate-migration-duluth.html ⊙ The Climate Change Paper So Depressing It's Sending People to Therapy https://www.vice.com/en_us/article/vbwpdb/the-climate-change-paper-so-depressing-its-sending-people-to-therapy ⊙ Deep Adaptation Post Sustainability and Post Societal Collapse https://www.resilience.org/stories/2019-03-17/deep-adaptation-post-sustainability-and-the-possibility-of-societal-collapse/ ⊙ New Climate Debate: How to Adapt to the End of the World https://www.bloomberg.com/news/articles/2018-09-26/new-climate-debate-how-to-adapt-to-the-end-of-the-world ⊙ Sustainable Missoula: Climate change, migration resilient Missoula for all https://missoulacurrent.com/opinion/2019/03/climate-change-migration/ ⊙ 'We're moving to higher ground': America's era of climate mass migration is here https://www.theguardian.com/environment/2018/sep/24/americas-era-of-climate-mass-migration-is-here
25. An American Authoritarian State	⊙ The Future of Democracy - OECD http://www.oecd.org/futures/thefutureofdemocracy.htm ⊙ The Rise of Authoritarianism https://sydney.edu.au/news-opinion/sydney-ideas/2018/the-rise-of-authoritarianism.html ⊙ Democracy is Retreating, Authoritarianism is Rising https://www.belfercenter.org/publication/democracy-retreating-authoritarianism-rising ⊙ National security experts warn of rise in authoritarianism https://thehill.com/policy/national-security/431646-national-security-experts-warn-of-rise-in-authoritarianism-efforts ⊙ Eight simple steps to fix American democracy https://www.newstatesman.com/world/north-america/2018/11/eight-simple-steps-fix-america-democracy
26. Digital Countries	⊙ E-Estonia https://e-estonia.com/ ⊙ Could Estonia be the first 'digital' country? http://www.bbc.com/future/story/20171019-could-estonia-be-the-first-digital-country ⊙ Imagine a community as connected as a forest ecosystem https://living-future.org/lcc/basics/ ⊙ The future of governance is not Governments https://medium.com/metacurrency-project/the-future-of-governance-is-not-governments-9c894e17b1cd ⊙ 10 Bizarre Hypothetical Forms Of Government http://listverse.com/2015/05/07/10-bizarre-hypothetical-forms-of-government/ ⊙ 12 Futuristic Forms of Government That Could One Day Rule the World https://io9.gizmodo.com/12-futuristic-forms-of-government-that-could-one-day-ru-1589833046 ⊙ Blockchain, Burning Man And The Future Of Governance: A Conversation With John Clippinger

	https://www.forbes.com/sites/robertwolcott/2017/02/16/blockchain-burning-man-and-the-future-of-governance-a-conversation-with-john-clippinger/#1de933901b0b ⊙ The Past, Present, and Future of Community Development in the United States http://www.whatworksforamerica.org/ideas/the-past-present-and-future-of-community-development-in-the-united-states/#.XOX6EohKiM8
27. Death of Pricing	⊙ Reducing Supermarket Food Waste with Dynamic Pricing https://progressivegrocer.com/reducing-supermarket-food-waste-dynamic-pricing ⊙ This Bottle of Pills Costs $20 in One State and $130 in Another https://www.bloomberg.com/graphics/2019-drug-spread-states/ ⊙ This startup wants to make drugs cheaper with "behavior-based" pricing https://www.bizjournals.com/sanfrancisco/news/2018/08/30/startup-wants-cheaper-drugs-behavior-pricing.html ⊙ The 'Amazon Effect' Is Changing Online Price Competition—and the Fed Needs to Pay attention https://hbswk.hbs.edu/item/the-amazon-effect-is-changing-online-price-competition-and-the-fed-needs-to-pay-attention ⊙ The death of prices https://www.axios.com/future-of-retail-amazon-surge-pricing-brick-and-mortar-b6a5f9fe-130f-4601-b96f-a3dc7a69b54e.html ⊙ Personalized pricing, the future of dynamic pricing https://www.minderest.com/blog/2018/10/18/personalised-pricing-future-dynamic-pricing
28. End of Abortion Rights	⊙ Self-Managed Medication Abortion: Expanding the Available Options for U.S. Abortion Care https://www.guttmacher.org/gpr/2018/10/self-managed-medication-abortion-expanding-available-options-us-abortion-care ⊙ Abortions by mail are available now in the US. Here's what you need to know. https://www.vox.com/science-and-health/2018/10/20/17999996/abortion-mail-online-mifepristone-misoprostol ⊙ Medical Abortions Have Changed Abortion Access — And They're Available on the Internet https://www.pbs.org/wgbh/frontline/article/self-managed-induced-medication-abortion/ ⊙ MOMS WITH MULTIPLE JOBS HAVE HIGHER DEPRESSION RISK https://www.futurity.org/mothers-multiple-jobs-depression-2069092/ ⊙ Reproductive Rights Groups Tell FDA to Stop Restricting Medication Abortion https://rewire.news/article/2019/07/01/reproductive-rights-groups-tell-fda-to-stop-restricting-medication-abortion/ ⊙ The bitter Pill: Why isn't birth control better? https://www.vox.com/the-goods/2019/6/25/18715504/birth-control-side-effects-pill-iud ⊙ Restrictions to abortion access hurt public health, data shows. Here's how. https://www.everydayhealth.com/womens-health/abortion-restriction-hurts-public-health-data-shows/ ⊙ How Banning Abortion Will Transform America https://www.project-syndicate.org/commentary/alabama-georgia-abortion-laws-like-communist-romania-by-maria-bucur-and-kristen-r-ghodsee-2019-05 ⊙ The Threat That Climate Change Poses to Women's Health Is Real https://rewire.news/article/2019/04/22/the-threat-that-climate-change-poses-to-womens-health-is-real/

	⊙ The Rising U.S. Maternal Mortality Rate Demands Action from Employers https://hbr.org/2019/06/the-rising-u-s-maternal-mortality-rate-demands-action-from-employers ⊙ In Alabama — where lawmakers banned abortion for rape victims — rapists' parental rights are protected https://www.washingtonpost.com/national/in-alabama--where-lawmakers-banned-abortion-for-rape-victims--rapists-parental-rights-are-protected/2019/06/09/6d2aa5de-831b-11e9-933d-7501070ee669_story.html?utm_term=.c1f40a4e7732 ⊙ Child brides: Heather was only 15 when she said 'I do'. She was also pregnant https://www.bbc.co.uk/bbcthree/article/fb2ba47b-8d50-4df1-aa42-b756e9fb26b4
29. End of Meat in Global Food Supply	⊙ A Five-Step Plan to Feed the World https://www.nationalgeographic.com/foodfeatures/feeding-9-billion/ ⊙ Switching to plant-based protein could increase America's food supply by a third https://www.economist.com/graphic-detail/2018/10/16/switching-to-plant-based-protein-could-increase-americas-food-supply-by-a-third ⊙ Artificial Meat? Food for Thought for 2050 https://ourworld.unu.edu/en/artificial-meat-food-for-thought-for-2050 ⊙ Forecast | The end of meat in 2035: Future of Food P2 https://www.quantumrun.com/prediction/vegetarians-will-reign-supreme-after-meat-shock-2035-future-food-p2 ⊙ The fight against 'fake meat' has officially begun https://www.cnbc.com/2018/02/23/the-fight-against-fake-meat-has-officially-begun.html ⊙ Our Meatless Future: How The $90B Global Meat Market Gets Disrupted https://www.cbinsights.com/research/future-of-meat-industrial-farming/ ⊙ Is a vegetarian diet really more environmentally friendly than eating meat? http://theconversation.com/is-a-vegetarian-diet-really-more-environmentally-friendly-than-eating-meat-71596 ⊙ The Impossible is here, and over there https://impossiblefoods.com/ ⊙ The case for plant based https://www.sustain.ucla.edu/our-initiatives/food-systems/the-case-for-plant-based/

30. Disparity of climate crisis impacts on food supply	⊙ Western culture is to blame for rising childhood obesity in developing countries https://www.independent.co.uk/voices/obesity-uk-usa-developing-countries-western-culture-chains-a8002026.html ⊙ For people facing hunger, poverty is just one issue https://www.feedingamerica.org/hunger-in-america/facts ⊙ 11 Facts about Hunger in the US https://www.dosomething.org/us/facts/11-facts-about-hunger-us ⊙ Hunger & Poverty in America https://frac.org/hunger-poverty-america ⊙ Facts About Childhood Hunger https://www.nokidhungry.org/who-we-are/hunger-facts ⊙ Hunger in America: United States hunger and poverty facts https://www.worldhunger.org/hunger-in-america-united-states-hunger-poverty-facts-2018/ ⊙ Why are People Malnourished in the Richest Country on Earth? https://www.nationalgeographic.com/foodfeatures/hunger/
31. Data Sovereignty	⊙ As FTC cracks down, data ethics is now a strategic business weapon https://techcrunch.com/2019/07/12/as-ftc-cracks-down-data-ethics-is-now-a-strategic-business-weapon/ ⊙ Has Google's data collection gone too far? https://www.dw.com/en/has-googles-data-collection-gone-too-far/a-49531478 ⊙ YouTube has been harvesting kids' data for years and the FTC seems fine with that https://news.vice.com/en_us/article/vb9kwm/youtube-has-been-harvesting-kids-data-for-years-and-the-ftc-seems-fine-with-that?utm_source=reddit.com ⊙ Demanding privacy and establishing trust in digital health https://techcrunch.com/2019/03/26/demanding-privacy-and-establishing-trust-in-digital-health/ ⊙ Delete yourself from the Internet's people-search sites: is it worth it? https://www.usatoday.com/story/tech/columnist/2018/05/04/delete-yourself-internet-people-finder-sites-worth/553371002/
32. Radical Transparency	⊙ Technology enabling radical transparency in business https://www.virgin.com/entrepreneur/technology-enabling-age-radical-transparency-within-business ⊙ Radical Transparency Can Reduce Bias but only if done right https://hbr.org/2017/10/radical-transparency-can-reduce-bias-but-only-if-its-done-right ⊙ Transforming Healthcare through Radical Transparency https://www.forbes.com/sites/stevedenning/2013/04/10/transforming-health-care-through-radical-transparency/#a143dff19cd1 ⊙ Do We Need Public Scrutiny of Automated Decisions https://www.forbes.com/sites/adigaskell/2018/03/02/do-we-need-public-scrutiny-of-automated-decisions/#1440139553b1 ⊙ Blockchain Technology may fix Healthcare Just Don't Hold your Breath https://www.forbes.com/sites/jeffgorke/2019/03/28/blockchain-technology-may-eventually-fix-healthcare-just-dont-hold-your-breath/#3c929cb5820d
33. Ending Pain and Anxiety through DNA	⊙ How a Scottish Woman Endured Burns, Broken Bones, Childbirth and Surgeries Without Ever Feeling Pain https://time.com/5560375/scottish-woman-feels-no-pain/ ⊙ Gene Therapy for Chronic Pain https://www.technologyreview.com/s/409448/gene-therapy-for-chronic-pain/

	⊙ Scottish woman Jo Cameron feels no pain, and is always in a good mood, because of rare genetic mutation https://inews.co.uk/news/health/why-one-woman-in-scotland-feels-no-pain/ ⊙ Scottish woman with gene mutation feels no pain https://www.scotsman.com/news-2-15012/scottish-woman-with-gene-mutation-feels-no-pain-1-4897186 ⊙ Opioid Overdose Crisis https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis ⊙ Want to Reduce Opioid Deaths? Get People the Medications They Need https://www.nytimes.com/2019/03/26/opinion/opioid-crisis-sacklers-purdue.html
34. Zombie Viruses and Toxic Threats Emerging From Melting Permafrost	⊙ Thawing Permafrost May Reawaken Old Diseases http://now.northropgrumman.com/thawing-permafrost-may-reawaken-old-diseases/ ⊙ Melting permafrost in the Arctic is unlocking diseases and warping the landscape https://www.vox.com/2017/9/6/16062174/permafrost-melting ⊙ Artic Meltdown: We're Already Feeling the Consequences of Thawing Permafrost http://discovermagazine.com/2018/jun/something-stirs ⊙ As Earth Warms, the Diseases That May Lie within Permafrost Become a Bigger Worry https://www.scientificamerican.com/article/as-earth-warms-the-diseases-that-may-lie-within-permafrost-become-a-bigger-worry/?redirect=1 ⊙ Are There Zombie Viruses In The Thawing Permafrost? https://www.npr.org/sections/goatsandsoda/2018/01/24/575974220/are-there-zombie-viruses-in-the-thawing-permafrost ⊙ 5 diseases climate change may awaken from melted permafrost https://www.salon.com/2017/11/11/5-diseases-climate-change-may-awaken-from-melted-permafrost_partner/ ⊙ Intergenerational contagion: diseases trapped in ice https://cosmosmagazine.com/geoscience/intergenerational-contagion-diseases-trapped-in-ice ⊙ Earth's Ancient Life Forms Are Awakening After 40,000 Years in Permafrost https://www.sciencealert.com/ancient-plants-and-animals-reawaken-after-40-000-years-of-the-deepest-icy-slumbers
35. Ready Player, Escape	⊙ New research: the world is sadder, angrier than ever before https://futurism.com/the-byte/world-sadder-angrier-emotions ⊙ Reconnecting the elderly with the joys of everyday life through virtual reality https://medium.com/@MassChallengeHT/reconnecting-the-elderly-with-the-joys-of-everyday-life-through-virtual-reality-277bf957483e ⊙ On guilt and post-truth escapism: developing a theory https://journals-sagepub-com.eres.library.manoa.hawaii.edu/doi/full/10.1177/0191453718794752 ⊙ The moderating role of psychosocial well-being on the relationship between escapism and excessive online gaming https://www.sciencedirect.com/science/article/pii/S0747563214002982 ⊙ Everything parents need to know about e-sports https://www.washingtonpost.com/lifestyle/2018/10/12/everything-parents-need-know-about-esports/?utm_term=.d2d500d95c5f ⊙ Do coping strategies moderate the relationship between escapism and negative gaming outcomes in World of Warcraft players?

	https://www.sciencedirect.com/science/article/pii/S0747563218301948 ⊙ Coping with stress or losing control? Facebook-induced strains among emerging adults as a consequent of escapism versus procrastination https://www.nomos-elibrary.de/10.5771/9783845280455-167/coping-with-stress-or-losing-control-facebook-induced-strains-among-emerging-adults-as-a-consequence-of-escapism-versus-procrastination ⊙ *Black Mirror* isn't about tech, it's about tech's social implications https://dgit.com/black-mirror-social-implications-54270/
36. Technohubris in health	⊙ Healthcare needs less #innovation https://www.statnews.com/2019/04/12/health-care-needs-less-innovation/ ⊙ Stealth research: lack of peer-reviewed evidence from healthcare unicorns https://onlinelibrary.wiley.com/doi/full/10.1111/eci.13072 ⊙ The latest Instagram influencer frontier? Medical promotions. https://www.vox.com/the-goods/2019/2/15/18211007/medical-sponcon-instagram-influencer-pharmaceutical ⊙ Crowdfunding drives funds and attention toward questionable medical treatments https://www.npr.org/sections/health-shots/2019/01/02/674385287/crowdfunding-drives-funds-and-attention-toward-questionable-medical-treatments ⊙ Theranos employees struggle to put scandal behind them https://www.cnn.com/2019/03/14/tech/theranos-employees/index.html ⊙ Is this the end of wellness? https://www.theguardian.com/lifeandstyle/2019/jul/14/eva-wiseman-is-this-the-end-of-wellness ⊙ Gwyneth Paltrow's Goop under fire for selling potentially dangerous product to pregnant women ⊙ https://www.usmagazine.com/celebrity-news/news/gwyneth-paltrows-goop-under-fire-for-selling-potentially-dangerous-product/
37. Humans Training Machines to Train Humans	⊙ Machine teaching outperforms human teaching – AI to revolutionize education https://bigdata-madesimple.com/machine-teaching-outperforms-human-teaching-ai-to-revolutionize-education/ ⊙ Intelligent Machines Will Teach Us—Not Replace Us https://www.wsj.com/articles/intelligent-machines-will-teach-usnot-replace-us-1525704147 ⊙ AI algorithm with 'social skills' teaches humans how to collaborate https://www.kurzweilai.net/ai-algorithm-teaches-humans-how-to-collaborate ⊙ How AI Will Rewire Us https://www.theatlantic.com/magazine/archive/2019/04/robots-human-relationships/583204/ ⊙ Machines Teaching Each Other Could Be the Biggest Exponential Trend in AI https://singularityhub.com/2018/01/21/machines-teaching-each-other-could-be-the-biggest-exponential-trend-in-ai/ ⊙ Will artificial intelligence replace doctors? https://news.aamc.org/medical-education/article/will-artificial-intelligence-replace-doctors/ ⊙ Humans are on the verge of merging with machines https://www.fastcompany.com/90373620/yuval-noah-harari-humans-are-on-the-verge-of-merging-with-machines ⊙ 'Google Inside Your Head': Brain Implants To Revolutionize AI For Humans

	https://www.technocracy.news/google-inside-your-head-brain-implants-to-revolutionize-ai-for-humans/
38. Biased Algorithms	⊙ How algorithms can create inequality in health care, and how to fix it https://medicalxpress.com/news/2018-12-algorithms-inequality-health.html ⊙ If AI is going to be the world's doctor, it needs better textbooks https://qz.com/1367177/if-ai-is-going-to-be-the-worlds-doctor-it-needs-better-textbooks/ ⊙ Facebook's ad-serving algorithm discriminates by gender and race https://www.technologyreview.com/s/613274/facebook-algorithm-discriminates-ai-bias/ ⊙ Addressing the Biases Plaguing Algorithms https://hbr.org/2019/05/addressing-the-biases-plaguing-algorithms ⊙ Yes, "algorithms" can be biased. Here's why https://arstechnica.com/tech-policy/2019/01/yes-algorithms-can-be-biased-heres-why/ ⊙ Biased Algorithms Are Everywhere, and No One Seems to Care https://www.technologyreview.com/s/608248/biased-algorithms-are-everywhere-and-no-one-seems-to-care/
39. Changing Understanding of and Response to Racism	⊙ Antiracist Research and Policy Center https://antiracismcenter.com/ ⊙ How to be an Anti-Racist, Kendi, Ibram X., Penguin Books, August, 2019 ⊙ Aspen Ideas Institute https://www.aspenideas.org/speakers/ibram-x-kendi
40. Extreme Longevity for the Few	⊙ Want to live forever? Flush out your zombie cells https://www.theguardian.com/science/2018/oct/06/race-to-kill-killer-zombie-cells-senescent-damaged-ageing-eliminate-research-mice-aubrey-de-grey ⊙ Is the Secret to Significantly Longer Life Hidden in Our Cells? https://singularityhub.com/2018/05/03/is-the-secret-to-significantly-longer-life-hidden-in-our-cells/#sm.001jkvj8teb8doi11712eaah93nct ⊙ Opportunities and Challenges of a World with Negligible Senescence https://www.sciencedirect.com/science/article/pii/S0040162515001985
41. "Everywhere" Living Online	⊙ Fortnite was 2018's most important social network https://www.theverge.com/2018/12/21/18152012/fortnite-was-2018s-most-important-social-network ⊙ More than a game, Fortnite is emerging as the best new social network https://www.fastcompany.com/90315238/the-best-new-social-network-may-surprise-you ⊙ Beyond Gaming: How 'Fortnite' Is Disrupting Traditional Marketing on YouTube and Facebook https://tubularinsights.com/fortnite-marketing-youtube-facebook/ ⊙ Fortnite: The hot, new social network https://www.axios.com/fortnite-the-hot-new-social-network-45cc0576-a49f-467f-b3aa-b5e06ec8aa53.html ⊙ Could Fortnite Be The Next Great Social Media Site? https://socialmediahq.com/could-fortnite-be-the-next-great-social-media-site/ ⊙ Ten ways Fortnite is like a social network

	https://medium.com/lightspeed-venture-partners/ten-ways-fortnite-is-like-a-social-network-3af5e6602a95 ⊙ Why Fortnite's Most Unexpected Predecessor Is... Second Life https://nwn.blogs.com/nwn/2018/12/fortnite-second-life-cory-ondrejka.html ⊙ Fortnite teams with Weezer in attempt to become the next Second Life https://arstechnica.com/gaming/2019/03/fortnite-teams-with-weezer-in-attempt-to-become-the-next-second-life/ ⊙ Fortnite Is the Future, but Probably Not for the Reasons You Think https://redef.com/original/fortnite-is-the-future-but-probably-not-for-the-reasons-you-think ⊙ I Played Fortnite and Figured Out the Universe: The best strategy is blasting everyone you see—until it's not. https://www.theatlantic.com/technology/archive/2018/05/i-played-fortnite-and-figured-out-the-universe/559940/
42. Machine Charities	⊙ Buttice, Claudio. (2018, June 13). *4 AI Advances that Will Benefit Charity and Humanitarian Services. Techopedia.* https://www.techopedia.com/4-ai-advances-that-will-benefit-charity-and-humanitarian-services/2/33336 ⊙ Charities Aid Foundation. (2015). *Giving Unchained: Philanthropy and the Blockchain. Giving Thought discussion paper no. 4. Charities Aid Foundation.* https://www.cafonline.org/docs/default-source/about-us-publications/givingunchained-philanthropy-and-the-blockchain.pdf ⊙ Chartan, Debrah. (2018, March 11). *AI could help your charitable dollars go further. VentureBeat.* https://venturebeat.com/2018/03/11/ai-could-help-your-charitable-dollars-go-further/ ⊙ Davies, Rhodri. (2015, December 16). *Philanthropy, Blockchain and the Internet of Things. Charities Aid Foundation.* https://www.cafonline.org/about-us/blog-home/giving-thought/the-future-of-doing-good/philanthropy-the-blockchain-the-internet-of-things ⊙ Optimy. (2018, November 8). *The Future of Technology in Philanthropy.* https://blog.optimy.com/the-future-of-technology-in-philanthropy/
43. World without Money	⊙ How to Run a Business in the Gift Economy https://www.shareable.net/how-to-run-a-business-in-the-gift-economy/ ⊙ What Is Fast Fashion? https://goodonyou.eco/what-is-fast-fashion/ ⊙ The true cost of your cheap clothes: slave wages for Bangladesh factory workers https://www.scmp.com/magazines/post-magazine/article/1970431/true-cost-your-cheap-clothes-slave-wages-bangladesh-factory ⊙ Way better than a rental car: Why Truro? https://turo.com/rentals ⊙ Understanding the Gifting Economy of the Burn https://www.dustydepot.com/playa-guide/gifting-at-burning-man ⊙ Sacred Economics: Chapter 16, Transition to Gift Economy http://sacred-economics.com/sacred-economics-chapter-16-transition-to-gift-economy/ ⊙ My, How You've Grown: The Burning Man Effect in Nevada https://journal.burningman.org/2018/02/news/brc-news/my-how-youve-grown-the-burning-man-effect-in-nevada/

	⊙ How Burning Man created a commerce-free economy for 70,000 people https://www.msn.com/en-us/money/companies/how-burning-man-created-a-commerce-free-economy-for-70000-people/ar-BBMCxSN ⊙ The Wonderful, Weird Economy of Burning Man https://www.theatlantic.com/business/archive/2014/08/the-wonderful-weird-economics-of-burning-man/376108/ ⊙ The ever-growing sharing economy: Pros and cons https://www.eu-startups.com/2019/02/the-ever-growing-sharing-economy-pros-and-cons/ ⊙ 4 big trends for the sharing economy in 2019 https://www.weforum.org/agenda/2019/01/sharing-economy/ ⊙ The Sharing Economy - What It Is, Examples, And How Big Data, Platforms And Algorithms Fuel It https://www.forbes.com/sites/bernardmarr/2016/10/21/the-sharing-economy-what-it-is-examples-and-how-big-data-platforms-and-algorithms-fuel/#629574a87c5a
44. Living Medicine	⊙ Synbiobeta.com 2019. "Living Medicines: Engineering the Microbiome." https://synbiobeta.com/living-medicines-engineering-the-microbiome/ ⊙ CBC News, 2019. "You and your poo: Why fecal medicine could be the next big buzz." https://www.cbc.ca/news/health/poop-fecal-transplant-microbiome-bacteria-cancer-1.5022172 ⊙ Genome Medicine, 2018. "The microbiome in precision medicine: the way forward." https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5824491/ ⊙ MedicalXpress.com, 2019. "Transplanting gut bacteria alters depression-related behavior, brain inflammation in animals." https://medicalxpress.com/news/2019-05-transplanting-gut-bacteria-depression-related-behavior.html ⊙ ScienceDaily, 2019. "Gut microbiome directs the immune system to fight cancer." https://www.sciencedaily.com/releases/2019/04/190402081550.htm ⊙ ScienceDaily, 2019. "Autism symptoms reduced nearly 50 percent two years after fecal transplant." https://www.sciencedaily.com/releases/2019/04/190409093725.htm
45. Demographic Assumptions Overturned	⊙ *The World Might Actually Run Out of People*. https://www.wired.com/story/the-world-might-actually-run-out-of-people/ ⊙ Bricker, D. and Ibbitson, J. (2019, February 5). *The Empty Planet: The Shock of Global Population Decline*. New York: Robinson. ⊙ *Childlessness Up Among All Women; Down Among Women with Advanced Degrees*. Pew Research Center: Social & Demographic Trends. http://www.pewsocialtrends.org/2010/06/25/childlessness-up-among-all-women-down-among-women-with-advanced-degrees/ ⊙ *Worried About A Bleak Future, Climate Change Activists Hesitant to Have Kids. NPR: Environment*. https://www.npr.org/2016/08/28/491726848/activists-consider-the-climate-impact-of-having-children

	⊙ *Should We Be Having Kids In The Age Of Climate Change? NPR: Environment*. https://www.npr.org/2016/08/18/479349760/should-we-be-having-kids-in-the-age-of-climate-change ⊙ *Why Women Choose Not to Have Children. The Atlantic: Culture*. https://www.theatlantic.com/entertainment/archive/2015/04/why-women-arent-having-children/390765/ ⊙ *Why Climate Change Might Keep You From Becoming a Grandparent*. *Next Avenue*. https://www.nextavenue.org/climate-change-grandparent/ ⊙ *Conceivable Future* ("a women-led network of Americans bringing awareness to the threat climate change poses to reproductive justice, and demanding an end to US fossil fuel subsidies") http://conceivablefuture.org/about. ⊙ *Climate change 'impacts women more than men.'* BBC News. https://www.bbc.co.uk/news/science-environment-43294221 ⊙ *Women, Gender Equality and Climate Change* http://www.un.org/womenwatch/feature/climate_change/#threat ⊙ *Climate change leading to water shortage in Andes, Himalayas: Rapidly melting glaciers causing similar problems on two continents. ScienceDaily*. https://www.sciencedaily.com/releases/2018/12/181217101759.htm
46. Co-ops at the end of Capitalism	⊙ America Beyond Capitalism: A Socialist Stew Prepared for Liberals and Conservatives https://www.nyu.edu/projects/ollman/docs/america_beyond_capitalism.php ⊙ World's 26 richest people own as much as poorest 50%, says Oxfam https://www.theguardian.com/business/2019/jan/21/world-26-richest-people-own-as-much-as-poorest-50-per-cent-oxfam-report ⊙ Economic inequality and public demand for redistribution: combining cross-sectional and longitudinal evidence https://academic.oup.com/ser/article/14/1/119/2363019 ⊙ Beyond capitalism and socialism: could a new economic approach save the planet? https://www.theguardian.com/sustainable-business/2015/apr/21/regenerative-economy-holism-economy-climate-change-inequality ⊙ Capitalism and Inequality: What the Right and the Left Get Wrong https://www.foreignaffairs.com/articles/2013-02-11/capitalism-and-inequality ⊙ Reflections on Moving Beyond Capitalism http://www.geo.coop/story/reflections-moving-beyond-capitalism ⊙ Communal Living, Barter Systems, Shared Energy: What Will Future Communities Look Like? https://edgy.app/communal-living-future-communities ⊙ I was wrong about Extinction Rebellion. This is why. https://newint.org/features/2019/04/30/i-was-wrong-about-extinction-rebellion-why ⊙ The global elite is destroying our planet. So why are Extinction Rebellion activists the ones in the dock? https://www.independent.co.uk/voices/extinction-rebellion-climate-change-global-elite-capitalism-a8876711.html
47. Redefining childbearing	⊙ How Artificial Exo-wombs could change everything https://humanparagon.com/artificial-exo-wombs/ ⊙ An artificial womb successfully grew baby sheep — and humans could be next https://www.theverge.com/2017/4/25/15421734/artificial-womb-fetus-biobag-uterus-lamb-sheep-birth-premie-preterm-infant ⊙ This Artificial Womb Could Revolutionize the Way We Treat Premature Babies

	https://gizmodo.com/this-artificial-womb-could-revolutionize-the-way-we-tre-1794605838 ⊙ Feminists, get ready: pregnancy and abortion are about to be disrupted https://www.theguardian.com/commentisfree/2015/oct/12/feminists-get-ready-pregnancy-and-abortion-are-about-to-be-disrupted ⊙ The Tragic Connection Between Race, Birth and Death https://belatina.com/the-connection-between-race-birth-and-death/
48. Zoonotic infection	⊙ The Scientist.com, 2018. "Predicting Future Zoonotic Disease Outbreaks." https://www.the-scientist.com/features/predicting-future-zoonotic-disease-outbreaks-64257 ⊙ The Telegraph.co.uk, 2019. "'High impact' outbreaks such as Ebola the 'new normal' WHO warns." https://www.telegraph.co.uk/news/0/high-impact-outbreaks-ebola-new-normal-warns/ ⊙ AmericanVeterinarian.com, 2018. "Increasing Detection of Emerging Zoonotic Pathogens." https://www.americanveterinarian.com/journals/amvet/2018/november2018/increasing-detection-of-emerging-zoonotic-pathogens ⊙ ScienceDaily.com, 2019. "Habitat loss linked to global emergence of infectious diseases." https://www.sciencedaily.com/releases/2019/06/190624111612.htm ⊙ MedicalXpress.com, 2019. "Urban wildlife may be a significant vector for antimicrobial resistant germs." https://medicalxpress.com/news/2019-06-urban-wildlife-significant-vector-anti-microbial.html
49. Runaway microbial tribbles	⊙ PLOS.org, 2019. "Using Synthetic Biology to Fight Environmental Pollution, New Insights into an Old Problem." https://blogs.plos.org/synbio/2019/03/04/using-synthetic-biology-to-fight-environmental-pollution-new-insights-into-an-old-problem/ ⊙ Baltimore Sun, 2016. "Student Scientists Engineer Bacteria to Break Down Plastic, Hope to Help Clean Baltimore Harbor." https://www.baltimoresun.com/maryland/bs-md-plastic-eating-bacteria-20161116-story.html ⊙ EuropeanScientist.com, 2019. "Can Plastic-Eating Bacteria Help Solve the Plastic Pollution Problem?" https://www.europeanscientist.com/en/environment/can-plastic-eating-bacteria-help-solve-the-plastic-pollution-problem/ ⊙ Vox.com, 2019. "The Race to Save the Planet from Plastic." https://www.vox.com/the-highlight/2019/4/9/18274131/plastic-waste-pollution-bacteria-digestion ⊙ TheScientist.com, 2015. "Controlling Synthetic Bacteria." https://www.the-scientist.com/daily-news/controlling-synthetic-bacteria-34379
50. Kids-curing-kids	⊙ Brookings, 2017. "Do-it-yourself biology shows safety risks of an open innovation movement." https://www.brookings.edu/blog/techtank/2017/10/09/do-it-yourself-biology-shows-safety-risks-of-an-open-innovation-movement/ ⊙ Motherboard.com, 2016. "Accessible Synthetic Biology Raises New Concerns for DIY Biological Warfare." https://www.vice.com/en_us/article/4xaqyp/accessible-synthetic-biology-raises-new-concerns-for-diy-biological-warfare

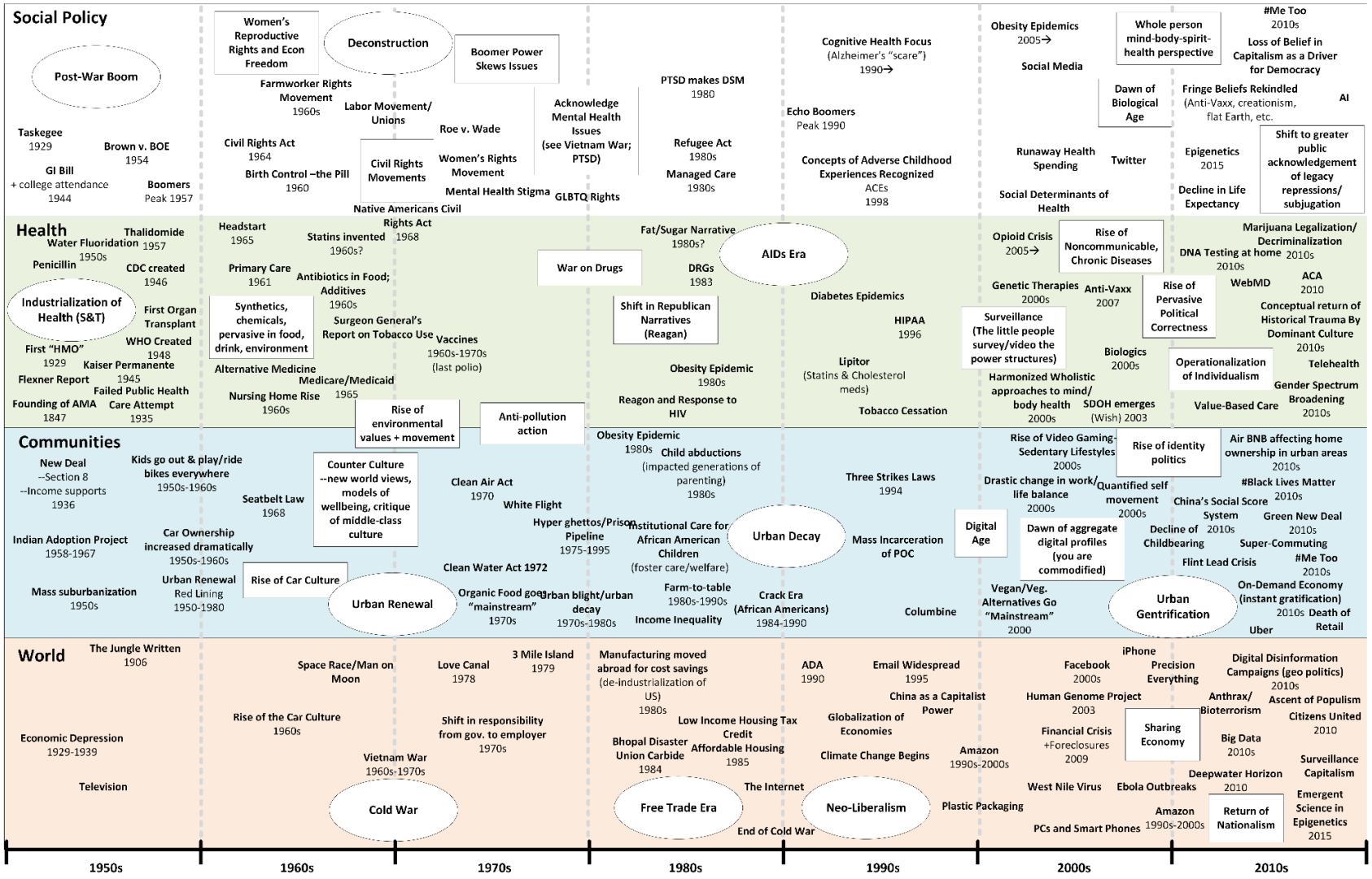
	⊙ Vox.com, 2019. "How Biohackers are Trying to Upgrade Their Brains, Their Bodies—and Human Nature." https://www.vox.com/future-perfect/2019/6/25/18682583/biohacking-transhumanism-human-augmentation-genetic-engineering-crispr ⊙ Vox.com, 2019. "A Celebrity Biohacker who sells DIY Gene-Editing Kits is Under Investigation." https://www.vox.com/future-perfect/2019/5/19/18629771/biohacking-josiah-zayner-genetic-engineering-crispr ⊙ Discovery Magazine, 2018. "In the Face of High Costs, DIYers Hope to Brew Their Own Insulin." http://blogs.discovermagazine.com/crux/2018/09/13/diy-insulin-make/#.XRtkuZNKjOQ
51. Editing Out Addiction	⊙ CRISPR Gene-Editing Technology Could Hold Key to Understanding Addition https://www.forbes.com/sites/daviddisalvo/2017/11/14/crispr-gene-editing-technology-could-also-hold-the-key-to-understanding-addiction/#4c3f5b1f51a8 ⊙ CRISPR gene editing creates cocaine-proof mice, aims to crack addiction puzzle https://www.digitaltrends.com/cool-tech/crispr-editing-cocaine-proof-mouse/ ⊙ Gene-Edited, Less Addictive Tobacco Could Help You Quit Smoking https://futurism.com/the-byte/gene-edited-less-addictive-tobacco-smoking ⊙ What CRISPR Gene Editing Means for Addition https://www.promises.com/blog/crispr-gene-editing-means-addiction/ ⊙ CRISPR Gene Editing Could One Day Cut Away Human Pain https://www.wired.com/story/crispr-gene-editing-could-one-day-cut-away-human-pain/

Appendix C: Raw Scan Hits

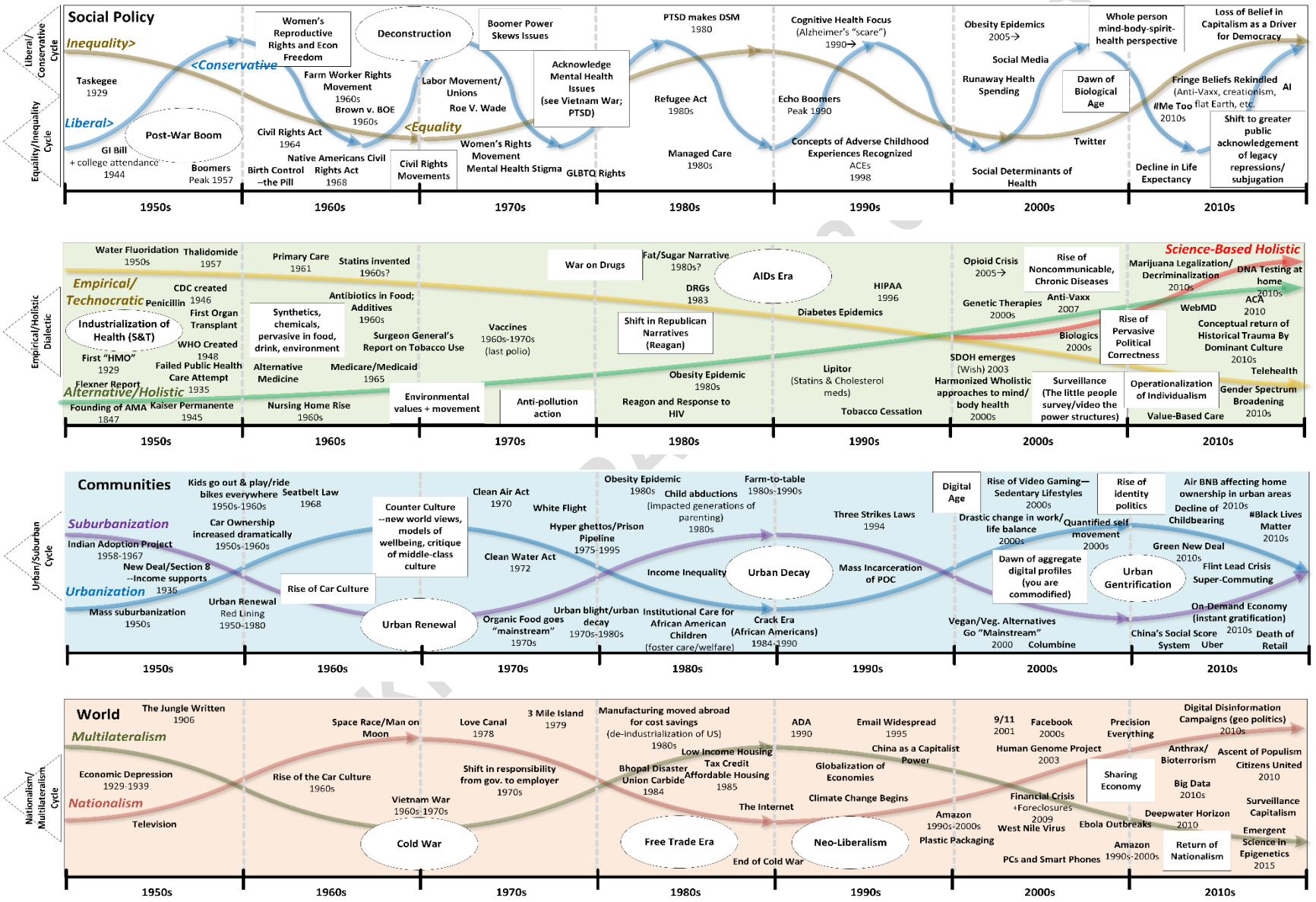
Separate document provided to FORESIGHT under separate cover. FORESIGHT is open to sharing this information with anyone interested. Please inquire at info@foresightforhealth.org.

Appendix D: Historical Timelines

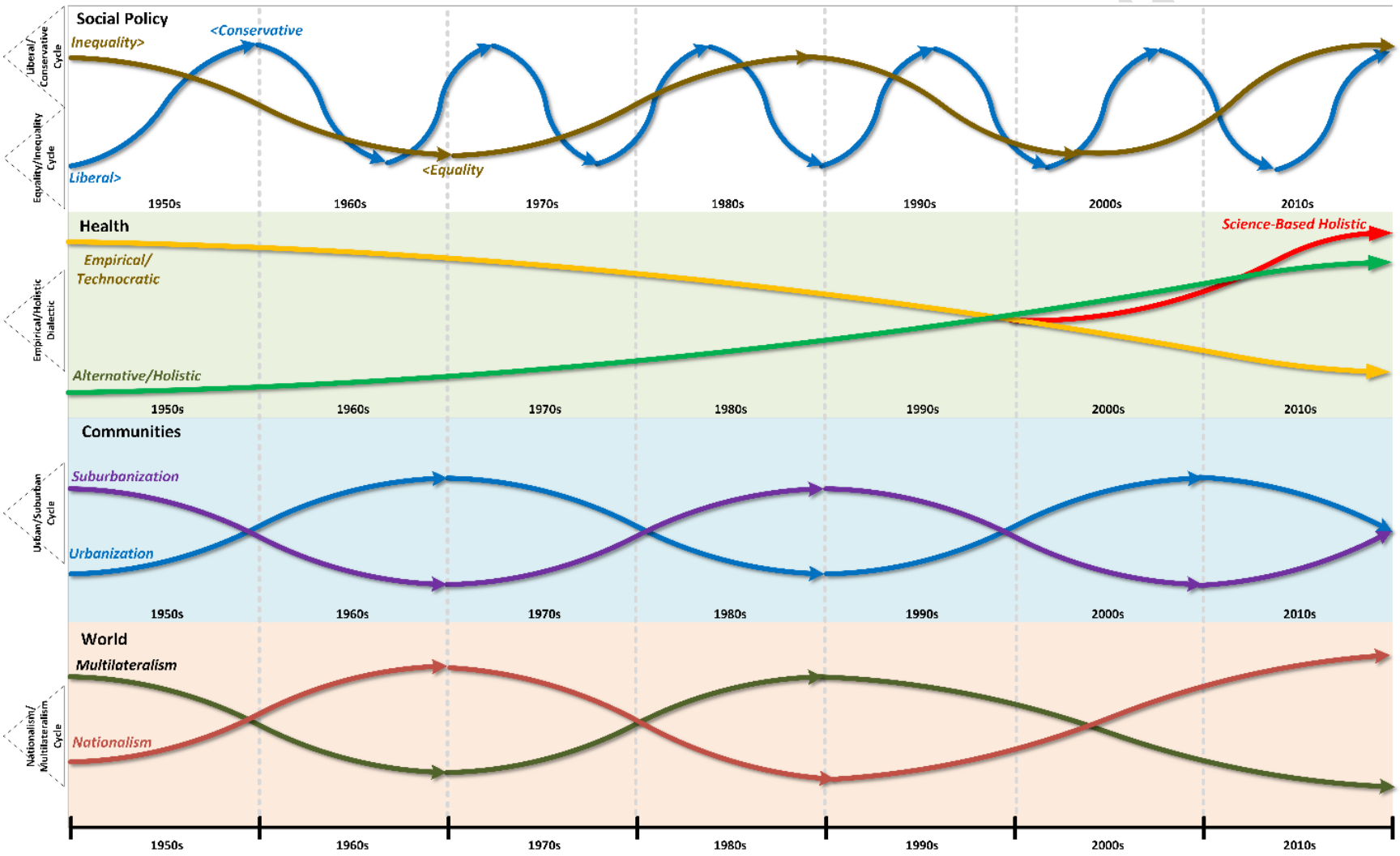
1. Full Mess Dress



2. Individual Layers with Change Curves



3. Summary Map with only Change Curves



Appendix E: Major Transformations

This appendix provides a full exploration of the nine major transformations outlined in the introduction to this report.

The futures building blocks identified in this report are not occurring in isolation to each other. Many share the same driving forces, and many more have the potential to combine in unexpected, transformational ways. In this appendix, we explore nine major transformations representing potential confluences of emerging issues, trends, disruptive combinations, emergent actors, and more, that we believe could disrupt wide swaths of society, including health and well-being. Decisionmakers should thus be aware of the potential implications of these transformations in order to avoid being overwhelmed by disruptions they may create tomorrow.

Digital Fabrication

Using machines to design and build individually, precisely, and quickly

Advanced digital fabrication tools dematerialize the global economy and could transform human health through on-demand, rejection-less organs for transplant.

Topic Area(s):	Technology, Economics
Timeframe:	Near to mid (mid for full organ printing and nanoscale printing)
Upstream TEIs:	CAD/CAM; 3D Printing; Personalized Medicine; Nanotechnology; Biotechnology
Dynamics of Change:	Exponential improvement; Moore's Law
Description:	Digital fabrication is the process of producing objects from digital designs (human or computer generated) using computer operated additive (3D printing) and subtractive (machining) manufacturing equipment. Digital fabrication today is mostly used to produce prototypes, single-material machine parts, and customized medical and dental implants, but many more applications are in development: printed buildings, printed human organs, printed food, and even printed printers. Digital fabrication tools are getting cheaper, faster, and more capable (higher resolution and able to handle more materials). In the future, advanced digital fabrication tools will be able to produce virtually any object or device, whether organic or inorganic, more efficiently using AI-aided design than traditional methods. The widespread availability of such printers, coupled with massive libraries of uploaded digital designs, will allow for the local production of any object, dramatically reshaping supply chains and global trade. Such technologies would also transform human health through on-demand printing of organs and tissues tailored to the individual patient.
Implications:	Advanced digital fabrication will dematerialize the global economy. The shipment of finished goods will be replaced with the online transfer of digital files and feedstock flows. Such tools will also enable the production of complex devices without the need for supporting manufacturing infrastructure, allowing individuals, organizations, and countries to quickly gain new technical capabilities—i.e. printing a stealth fighter jet without having an established aerospace industry. The pirating and hacking of digital design files and the ability to scan and print existing

	objects is also likely to significantly compromise intellectual property protections. The printing of organs, tissues, and potentially even full limbs will further question what it means to be human – especially when such replacement organs are better than the original.
Tackling the Transformation:	*Digital fabrication will allow users to create just about any object, including weapons. 3D printers are already being used to print guns, requiring arms control and technology export controls to be updated.* *The likely centrality of digital fabrication to the future economy also suggests the need to ensure that control of and access to printers and feedstocks is as democratic as possible.*

Environmental Breakdown

Our physical environment destabilized

The sum of human activity on our Earth has stressed all environmental systems. What crises will arise as we break more and more system limits, and how will we address and adapt to the resulting impacts?

Topic Area:	Climate change
Timeframe:	Mid to far (10 to 30 years)
Upstream TEIs:	Rising CO2 levels; melting glaciers; sea-level rise; destruction of rainforests; habitat encroachment; pervasive pollution
Dynamics of Change:	Environmental challenge and system response; societal collapse and rejuvenation.
Description:	Rising global temperature, growing ocean acidification, more frequent forest fires, expanding desertification, decreasing biodiversity, and more destructive weather are symptoms of a deeper problem. Human demands are exceeding the absorptive and productive capacity of global ecosystems. Unsustainable patterns of production and consumption are undermining the ecosystem services (i.e. the biochemical processes) that support life on the planet, leading to rapidly changing environments. For instance, Earth's atmosphere has a limited capacity to absorb carbon. In April 2018, we measured 411 ppm (parts per million) of carbon in the atmosphere – the highest measure yet, 50% higher than in 1880 – and the pace of increase is accelerating. Current science suggests that 450 ppm could be a major tipping point towards more severe changes. Over the next century, a new equilibrium could emerge that is distinctly unhealthy for humans, driving growing drought, food insecurity, rising sea levels, extreme temperatures, and severe weather. Human activities and the encroachment of human settlements on habitats threaten the extinction of both land and marine species, with extreme forecasts suggesting that the extinction of all non-domestic land animals could occur before 2030. Pervasive pollution – especially of microplastics – contributes to species vulnerability, including our own.
Implications:	Impacts include increased water stress, damage to the food chain, accelerating extinctions, increase in severe weather and

	flooding, desertification, increasing heat stress and stress on the immune system, increased spread of infectious diseases, infrastructure stress, damage to economic productivity, massive increases in the number of environmental refugees, and increasing potential for conflicts. No community will escape untouched. Additional impacts could arise from panicked attempts to geo-engineer solutions that might have side-effects worse than warming itself.
Tackling the Transformation:	*To survive and thrive, humankind must find a way to live within the carrying capacity of the planet. This means everyone everywhere must rethink current habits and lifestyles to envision a sustainable society, and transition paths to it. For decades people have thought that climate and environmental crises would happen elsewhere and else when, when in fact they are here already. The challenge is adapting to live with that reality. To make lasting progress, research should identify and monitor effective targets and metrics (human, economic and environmental), to ensure we live within Earth's carrying capacity. To guide effective action, we need to develop and incentivize sustainable production and consumption patterns*

Rise of Competing Points of View

Struggle for identity and truth and the struggle over culture

As the global center of economic gravity increasingly shifts East, Western culture's hold on global attention will slacken, and previously marginalized cultural voices and points of view will gain prominence. This could provide a useful critique of currently dominant assumptions.

Topic Area:	Culture shifts
Timeframe:	Near to mid.
Upstream TEIs:	Rising interest in Buddhist philosophy, yoga, qi-gong, and acupuncture; increasing popularity of anime and K-pop; rising economic influence of Singapore and South Korea; increasing economic and political influence of China globally and especially in Africa.
Dynamics of Change:	The rise and fall of empires, their spheres of influence, and worldviews.
Description:	The increasing size and strength of the Chinese economy is shifting the global economic center of gravity from the West (and the OECD) to the East. With the rise of Africa that center of gravity will shift over time further to the South. The decreasing inequality between countries as less developed economies catch up with the OECD is amplifying this trend. Increasingly interconnected markets bring more and more of the world's various goods into everyone's homes; increasingly interconnected media bring more and more of the world's cultural products into everyone's lives. Gens X, Y, and Z are exposed to greater diversity than their parents via both social media and ease of travel, resulting in growing conflict with the 'outmoded perspectives' and traditions of older generations still in power. Digitally connected generations are creating tribes of interest – for better and for worse – that identify with commonalities across cultures, and offer opportunities to import, trade, and blend different cultural perspectives. This diversifies the landscape of moral, ethical, and philosophical frames, creating a richer context for creative dialogue.

Implications:	One observable outcome of this shift is that the OECD countries are facing rising pressure to place respect for religious beliefs on equal terms with other values such as press and academic freedom or gender equality, e.g. acknowledging Halal accountancy, or a unique Sino-jurisdiction in law. At the individual level, people are increasingly exploring other cultural traditions for paths to personal health and well-being. At the level of global system change, people are increasingly making an effort to listen to and learn from older cultures. This includes acknowledging how many cultures have been marginalized and/or colonized and respecting how they are reclaiming their voices: it means valuing their contributions to addressing the grand challenges we all face.
Tackling the Transformation:	*This particular emerging transformation poses the risk of increased clashes of worldview – but also of increased splashes of creativity from the insert of new frames and perspectives into the world economy, and in the dialogue on global issues. Ancient cultures could contribute insights to help re-perceive problems we face today. Increased language education and cross-cultural instruction and exchange would prepare people to make the most of this.*

Machines

The built environment becomes its own ecosystem

An ever-expanding ecosystem of ever-more intelligent hard and soft machines transforms the way we live, our bodies, and even our minds.

Topic Area:	Technology, Economics
Timeframe:	Mid to far
Upstream TEIs:	Industrial automation; smart assistants; accelerating innovation; self-driving vehicles; prosthetics; machine learning
Dynamics of Change:	Exponential increase; Moore's Law, potential for runaway development with digital evolution
Description:	A complex ecosystem of autonomous and semi-intelligent machines becomes the backbone of society, with machines no longer merely producing goods or delivering transport services, but also providing companionship (caretaker robots, AI/robot pets/friends), warfighting, and even human augmentation (nanomedical bots and cybernetic implants).
Implications:	As innovative machine applications such as more advanced autonomous vehicles, more efficient industrial robots, and more capable AI personal assistants enhance our current way of doing things, they will drive significant gains in productivity. More novel applications could be truly transformative, changing how we live, fight, and think, like strong-AI (at least human-level intelligence), medical and industrial nanomachines, and cognitive cybernetic enhancements. These could change what it means to be human, requiring new laws and social norms—at what point do AI and intelligent machines warrant legal protections? civil rights? How do unmodified humans compete with the cybernetically enhanced? Can society control the use of AI weapons?
Tackling the Transformation:	*AI and machine learning are powerful tools that can benefit or harm society. Ensuring AIs and algorithms are unbiased will be key, as will be keeping humans 'in the loop.' The ethics behind both the deployment of AI systems and how society treats its AIs need to be fleshed out before true AI arrives.*

Post-scarcity Economics

The societal "heave" for a system that feels fairer and more right

The current economic system is swept away by technologies that provide universal access to goods—every product is open source/hackable/pirate-able—and eliminate most forms of work.

Topic Area:	Economics, Equity
Timeframe:	Far
Upstream TEIs:	Automation driving macroeconomic reform; reusable products and the zero-waste movement; machine charities; co-ops at the end of capitalism; world without money
Dynamics of Change:	A dialectic outcome: major socioeconomic disruption from automation (negative) combines with the advent of scarcity-eliminating technologies (positive) to yield a new economic system.
Description:	The current economic system—characterized by scarcity, the profit motive, and the protection of intellectual property—is undermined by the widespread availability of advanced, easy-to-use, nano-capable 3D-printers able to download/scan and print nearly any object, from a computer, to a real banana, to medications. This capability turns every person into a producer/designer/prescriber and every product into a generic. As space mining takes off, even the raw materials needed to make the most complex devices become ubiquitous. With both the means to produce printed products and the raw materials to do so growing ever cheaper, advances in AI-driven automation would eliminate the jobs that once enabled people to buy once expensive products.
Implications:	Universal access to goods, the undoing of intellectual property, and the loss of standard jobs would all necessitate new ways of structuring companies, the economy, and society. In a world where any object can be rapidly downloaded and printed, access to the printers and to the raw materials used by the printers will become key. With printers becoming ever cheaper (and self-printing) and with space mining likely to flood the market with cheap materials, even this potential bottleneck may be swept away. In a world where the bottleneck of constrained supplies persists or worsens, the impact may be a new form of scarcity-based economics. But for a world where the bottleneck is overcome, new socioeconomic systems become possible. These could include co-ops and sharing economies for printers and

	materials, and a form of AI-driven socialism that ensures equal access to them as well as universal distribution of goods.
Tackling the Transformation:	*The automation of most jobs, coupled with a major reduction in company profits due to loss of IP and the advent of perfect generics, will cause significant economic and social upheaval. Universal access to printers and raw materials is vital. Social programs like a universal basic income consisting of allotments of raw materials will likely be needed to supplant loss of traditional sources of income. Communal printer facilities will also be needed to ensure equitable access to printers.*

Privacy, Data, and the Right to Self

Who has access and influence over your actions and preferences?

The tug of war between privacy and privacy-invading technology grows stronger as the amount of potentially exploitable personal data grows and as surveillance systems proliferate.

Topic Area:	Culture Shifts, Technology
Timeframe:	Near
Upstream TEIs:	Ever-more capable and widespread surveillance systems; cyberattacks; right to be forgotten/reputation defense; end of personal privacy; personalized medicine; ubiquitous drones; social credit systems
Dynamics of Change:	Novel technologies create system disruptions and reorganization to a new system.
Description:	The confluence of data hacking, ubiquitous sensors and drones, and the quantification of all aspects of life (via social networks, wearable devices, etc.) is making personal privacy harder and harder to maintain. At the same time, it empowers those who control access to such information, whether through selling/hacking data or by running surveillance networks and social credit systems. In the future, new technologies like AI and quantum computing will amplify challenges to privacy, and by making secure encryption impossible, potentially end privacy altogether.
Implications:	The struggle over privacy – both data and physical – is likely to be a defining struggle of the 21st century. It currently seems destined to erode or eliminate privacy completely given a context of ubiquitous surveillance and data hacking. But the potential also exists for new privacy-enforcing tools that could even allow people to evade surveillance networks. How society responds to continued challenges to privacy will profoundly affect personal and societal well-being. Access to genetic data could create new forms of discrimination, while ubiquitous surveillance and social credit systems could create much more regimented and controlled societies. On the other hand, the rise of anti-surveillance zones and AI/quantum powered privacy tools could create powerful new communities beyond corporate or state control.

Tackling the Transformation:	*The ability or lack thereof to protect privacy will have profound implications for society. Privacy-protecting policies like the Right to Be Forgotten will become increasingly important to prevent new forms of discrimination.*

Rise of Authoritarianism

Wanting, promising, and being able to maintain power and control

After half a century of increasing liberalism, values and the political pendulum seem to be swinging back towards insular attitudes that demonize 'the other' and a desire for the reassurance of strong authorities.

Topic Area:	Culture shift, social contract.
Timeframe:	Near to mid
Upstream TEIs:	Increasing tribalism; increase in race / ethnic / culture conflict; rising populism and nationalism; increase in authoritarian regimes.
Dynamics of Change:	Social and political cycles alternating between open and closed, freedom and control, often in response to perceived level of threat.
Description:	Humanitarian and justice issues are defined by values and political structures, which in the 20th century appeared steadily progressive. Now populism is increasingly challenging democracy. Conservative autocrats – Putin, Erdogan, Duterte, Orban, Trump, Bolsonaro – are winning national leadership positions. Increasing numbers of people around the world are cheering a rise in populism and intolerance that is nationalist, repressive and regressive in terms of social justice, gender equity, care for children, and support for the needy and marginalized. Liberal values and points of view are being demonized. Leaders like Bolsonaro are explicitly editing the curricula of their nation's public schools and universities to remove progressive philosophies. Political leaders in the USA are marginally more subtle in simply gutting science infrastructure and starving the educational system of funding. As the other transformations we describe in this special report increasingly dismantle accepted ways of working, producing, living, and connecting, people will search for sources of stability in a rising sea of risk – such as strong leadership that promises to insulate them from change, and potential carriers of change. As perceptions of risk rise, people also demonize 'the other' – whoever seems to threaten the traditions and standing of

	the majority and those in power. This leads to increasing indifference to the fates of others – the rise of callousness.
Implications:	The vulnerable and marginalized will increasingly be at risk – and an increasing percentage of the population will be vulnerable and marginalized. The rise of callousness and growing political tribalism will exacerbate inequalities and diminish resources available to maintain community infrastructure and provide social services. This will further erode the quality of life for marginalized communities. Poverty among women and children will rise and their health will suffer. Increasing tensions are likely to increase use of incarceration as a means to manage/dispose of perceived underclasses and outsiders.
Tackling the Transformation:	*Addressing this transformation requires opening people's hearts and minds: an increase in empathy, and an increase in knowledge, for the people with whom we share the world. More outreach from community to community to let people work together to learn to live together, and more support for education, through all of life, that helps people think systemically and critically about their world, and learn all the ways that humans have devised for living in it.*

Synthetic Biology

Biology as engineering

Innovations in genetic editing and engineering allow researchers to create synthetic life with huge potential benefits. What unexpected outcomes - good and bad - could evolve along with these future synthetic lifeforms?

Topic Area:	Technology
Timeframe:	Near to mid.
Upstream TEIs:	Increasing ease and accuracy of genetic engineering; increasing use of edited stem cells and viruses, etc. in medicine; rise of biomimicry - developing new materials and structures based on patterns in nature; intersection with nanotechnology and micro-machines.
Dynamics of Change:	Novel technologies and innovations disrupting existing paradigms, assumptions, values, and structures.
Description:	Improvements in genetic manipulation tools like CRISPR-cas9 have accelerated explorations in synthetic biology, as seen in the iGEM student competition to design simple life-forms. At the microscopic level, innovations in nanotechnology and micromachine design may increasingly become indistinguishable from gene engineering, synthetic biology, and organic design. This could result in a capacity to create living tools and organic computers. New scientific paradigms focused on living systems are converging with tools to analyze and manipulate those systems, creating the potential to edit or design lifeforms and synthetic ecologies for human purposes. For example, biomimicry accelerates environmentally benign innovation by drawing upon designs found in nature and emulating living organisms' use of biochemical materials and processes, resulting in more efficient use of raw materials and fewer environmental impacts.
Implications:	In future, societies could potentially create built environments, infrastructure, and manufacturing processes based on living systems rather than mechanical ones. These innovations also make possible individually tailored medicine based on genetic manipulation of the human body and its microbiome.

	Biotechnology is increasingly used to produce pharmaceuticals - such as yeasts modified to produce morphine. Bio-design could address future humanitarian and environmental crises, via salt-tolerant food crops, renewable energy sources like algal biofuels, and organic bioremediation and climate change mitigation. Combining genes with sensitivity to an environmental factor (like arsenic in water), with a detectable metabolic response, creates living bacterial biosensors. In the future, the easiest way to design medical nanotechnology may be to 'domesticate' bacteria and viruses as programmable microbots. The upside is targeted health; the downside is weaponization. Entire species – and entire ecologies – could be redesigned, thanks to the capacity for creating 'gene drives' that build CRISPR-Cas9 RNA edits into reproductive mechanisms.
Tackling the Transformation:	*Synthetic biology and advances in genetic science will challenge humanity's ability to make ethical, responsible, and accountable decisions everywhere people could apply these tools.* *Professional ethics, as well as governmental oversight and regulation of such technologies, should draw upon multiple cultural and philosophical perspectives to encompass the potential impact on all life.*

Rise of the Self-Organized

The decentralizing possibilities of technology

Social networking, crowdsourcing, and real-time monitoring tools spawn a new form of people power—self-organized communities and movements able to challenge and even supplant the state.

Topic Area:	Social Contract
Timeframe:	Near to mid
Upstream TEIs:	Crowdsourcing; flash mobs; hacktivist collectives; online collectives; co-ops at the end of capitalism; "everywhere" living online; digital states
Dynamics of Change:	Linear in terms of the change in the nature of self-organizing; potentially exponential in terms of the number and power of self-organized movements
Description:	Civic activism is undergoing a major transformation thanks to digital age tools: social media is driving the rise of spontaneous, large-scale protest movements around the world (Arab Spring); citizens are using smartphone-shot videos to hold their governments to account (Black Lives Matter); and hacktivists are using cyberattacks to expose corruption (Anonymous/Panama Papers). Many governments are now trying to crack down on these self-organized movements. In the near to mid future, the combination of social networking, crowdsourcing, and the sharing economy may allow for a new form of people power—coherent self-organized communities with true economic power and material resources without geographic (or political) restrictions. With automation and real-time monitoring tools, the potential also exists for such communities to take on many of the roles of the state (monitoring for compliance, providing security, etc.). These communities will likely become more and more difficult for traditional governments to control.
Implications:	The growth of real-time citizen monitoring of organizations and governments coupled with the ability to mobilize the populace by sharing the results of that monitoring is transforming how governments interact with their citizens. As these self-organized networks and the tools they use grow more powerful and more numerous, they could potentially undermine states and also further fragment populations.

Tackling the Transformation:	*The reliance on digital tools to support citizen organization carries the risk of excluding populations without access to the internet. Ensuring universal access to such tools should be a priority. Self-organized movements and communities can be both positive and destructive for society (terrorists/racial supremacists). Society will need to consider what measures could limit the echo chamber / social media bubble and curtail hate speech—even though any such measures may ultimately prove ineffective.*

Appendix F: Full List of Wildcards

The following is the result of extended brainstorming, intended merely to generate a wide range of possibly useful wildcards.

- **Societal Wild Cards**
  - U.S. Civil War
    - Physical, violent conflict breaks out between the political left and political right in the US
  - Global Economic Collapse
    - A new Great Depression—worse than the 2008 Great Recession—as economies around the world shrink and global trade grinds to a halt
  - Happiness Quotient Replaces GDP
    - A redefining of how society measures economic and societal development
  - Nuclear War
    - A nuclear exchange between nations that causes massive destruction and potentially triggers a nuclear winter
  - Machine Government
    - Governments run by autonomous systems without human intervention
  - No More Secrets
    - New technologies not only end privacy, but also encryption and any other means of concealing data
- **Health Wild Cards**
  - Sperm Count Reaches Zero
    - Humans unable to reproduce without advanced IVF methods
  - Forced Euthanasia
    - People only get an allotted lifespan and no more
  - End of Illness
    - Health in a pill makes everyone happy—no more sickness
  - Radical Longevity/Immortality
    - Humans with no limit to lifespan
- **Technology Wild Cards**
  - Genetically engineered empathy
    - Humans with empathy toward others programed into their DNA

- Major Cyberattack
  - A widespread cyberattack that shuts down all of society (overloading power grids, water infrastructure, communications, etc.)
- Nuclear EMP
  - A high-altitude detonation of a nuclear warhead causing continent-wide disruption of electronics
- Strong AI Explosion
  - Major advances in AI lead to superhuman intelligent AIs that make humans obsolete
- Nanotech Explosion
  - Major advances in nanotech make atomic-level replication possible, putting an end to scarcity

Environmental Wild Cards

- Successful Geoengineering
  - Solar shades or other planet-scale engineering projects are successfully used to defeat climate change
- Global Environmental Collapse
  - Ecosystems around the world collapse along with mass extinctions, disrupting the natural systems on which civilization depends
- Extinction of Pollinators
  - Bees and other vital pollinators go extinct, greatly impacting world food supplies.
- Rapid/Extreme Sea Level Rise
  - Sea level rise from climate change happens much more rapidly and at higher levels than expected, displacing hundreds of millions of people
- Unsuccessful Geoengineering
  - A failed planet-scale engineering project triggers widespread ecological damage (global acid rain from a failed sulfuric acid injection into the atmosphere)